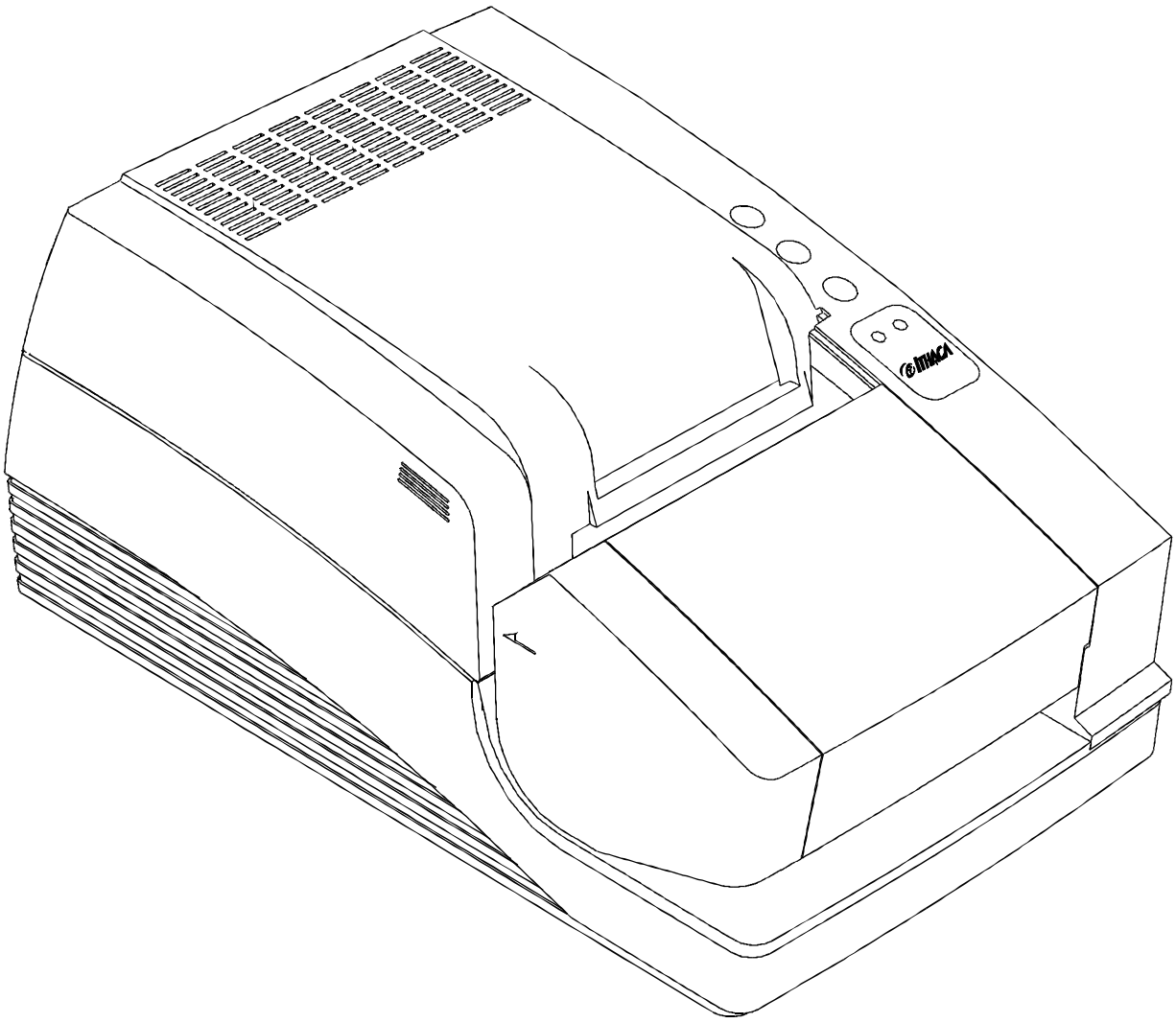
PCOS SERIES 90PLUS **Receipt/Validation/Journal Printers**

PROGRAMMER'S GUIDE

Rev L



Ithaca Peripherals

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Change History

Rev. L
Clarified cash drawer connectors on page 144
Changed IEEE-1284 to IEEE 1284 and Code 3 of 9 to Code 39

Rev. K
Reformatted entire document
Corrected miscellaneous grammar and spelling mistakes

Rev. J Update for Firmware Rev. 2.24
Corrected Epson documentation
Added documentation for justified bar codes and readable printing of bar codes
Added documentation for Bar code 93

Rev. I Update for Firmware Rev. 2.21
Corrected documentation for ENQ 15, 17, and 20 commands; length was 40H changed to 40 decimal
Added [ESC] z (&%FR) form release commands
Added features to graphic-save
Added OCR overlay features
Corrected miscellaneous grammar and spelling mistakes

Rev. H Update for Firmware Rev. 2.15
Improved description of pass-through and multidrop
Added features to [ESC]a command
Added M90PLUS
Removed references to Ithaca Peripherals
Corrected description of Mechanical Test Mode
Updated several graphic examples

Rev. G Update for Firmware Rev. 2.13
Added narrow, 2.4 inch print zone
Added [ESC]mP, [ESC]q<n>, and [ENQ]<17> commands
Changed documentation on [ENQ] commands to reflect that they are no longer buffered
Documented Epson cash drawer option
Fixed right margin specifications

Rev. F Update for Firmware Rev. 2.11
Added functionality to the RESET commands
Enabled [DLE][ENQ] <3> EPOS
Added M50 extension commands
Added rotated 270° font and 5 x 7 fonts to [ESC]P commands
Changed IPCL command &%CC to accept 3 decimal digits, was 2 digits
Corrected the description of the [ESC]J command. It does not start the next line at the left margin unless Auto-CR is on.
Updated the configuration table
Changed RS1284 references to IEEE-1284
Added Welsh and Thai character sets
Updated the cut command. The cutter does not have selectable cut. The cut command is now only 2 bytes.
Updated MICR section to include translation tables and field checking
Added 5 x 7 font to rotated print functions
Added sections on Windows Plug and Play
Added [ENQ]<20> (return all status) and [ENQ]<21> (return printer ID) commands
Added commands to allow the host to define a unique code page
Added autocutter position information
Added multidrop addressing
Added: the cash drawer will only provide 1.0 amp at 24V.

Rev. E Update for Firmware Rev. 2.07
Added 50 international language code pages
Altered Character Sets I and II. The printer no longer supports Character Set I and II. The printer is always in Set II.
Changed IPCL &%CP to support 4-digit code page descriptions

Extended the EPOS [ESC]R to support enhanced language sets
Updated code page table descriptions
Removed the Prerelease Change History
Corrected minimum slip width specification in the text for Figure 4

Rev D Update for Firmware Rev 2.05
Updated and clarified descriptions in the communication section
Added description of CTS and DSR controls
Added MICR commands and references to MICR Programmer's Guide
Updated configuration section to include MICR and communication CTS/RTS/DTR/DSR options
Added [ESC]y<2> and <3> commands to switch between EPOS and Normal modes
Added 4 inch resume on paper out

Rev C Update
Removed IPCL command for set rotated print line spacing
Shortened graphic-save buffer from 2014 characters to 2000
Removed second parameter of [ESC] [EM] B; set bar code height
Changed all validation and slip control IPCL commands to accept decimal parameters instead of binary
Removed set left and right margin IPCL commands
Removed set dynamic response from [ESC]y group and defined [ESC] to replace it
Updated inquire descriptions to reflect preprocessing of ENQ commands; previously, ENQ commands were processed with other commands.
Changed ENQ descriptions in the communication section to reflect command preprocessing
Reversed parallel-port responses to ENQ 1, 2, 5, 6, and 11; updated CFG90 to match
Reversed serial-port responses to ENQ 7 and 8; updated CFG90 to match
Redefined ENQ 9 to represent inquire buffer status
Added Epson mode [DLE] [EOT] and [DLE] [ENQ] commands

Rev B Update
Added eject-wait and pause commands and configuration information
Added print-suppress and display pass-through to both EPOS and Normal modes
Updated CFG90 to deal with the new modes

Rev A Initial Release

Disclaimer

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Federal Communications Commission Radio Frequency Interference Statement

The equipment complies with the limits for a Class A computing device in accordance with the specifications in Part 15 of the FCC rules which are designed to minimize radio frequency interference in the installation; however, there is no guarantee that radio or television interference will not occur in any particular installation. If the equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on while the radio or television is on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the radio or television receiving antenna.
- Relocate the printer with respect to the receiver.
- Plug the printer and receiver into different outlets.

If necessary, the user may consult their dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful: *How to Identify and Resolve Radio/TV Interference Problems.*

The booklet is available from the United States Government Printing Office, Washington, DC 20402. Ask for stock number 004-000-00345-4.

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1 Overview of the Series 90PLUS Printer

1.1 Warranty Information

1.1.1 Warranty Options

All Ithaca Peripherals Series 90PLUS printers come with a standard 12-month warranty covering both parts and labor. An optional warranty, covering both parts and labor for an additional twelve months, may be purchased separately. For more information concerning the warranty options, please contact your dealer or the Sales Department at Ithaca Peripherals.

Ithaca Peripherals
20 Bomax Drive
Ithaca, NY 14850
(607) 257-8901

1.1.2 Service Information

The printer may be serviced by a dealer, an independent service contractor, or by Ithaca Peripherals. If the printer is to be serviced by Ithaca Peripherals, a return authorization is required. Call Field Engineering at (607) 257-8901, and ask for a return authorization.

The printer will need to be packed in the original packing material and box and sent to Ithaca Peripherals. Information on how to ship the printer will be provided with the return authorization.

1.2 What is in this book?

1.2.1 Who should read this book?

This book is intended for system engineers or integrators. It contains the information needed to integrate the Series 90PLUS printer with a point-of-sale terminal and to program the terminal to communicate with the printer.

1.2.2 What does it cover?

The programmer's guide provides the following material:

- Start-up information including diagnostics and fault conditions
- Command descriptions
- Character fonts
- Printer features
- Parallel and RS-232 interface information
- Communications and buffers
- Command code reference tables

1.2.3 Where can you find more information?

An Operator's Guide is available that describes the setup and use of the Series 90PLUS printer. It describes basic procedures such as changing paper; printing on a slip or form; and replacing the ribbon cassette. A Maintenance Manual is also available; however, it is intended for trained, service technicians. For information about ordering these books or programs, refer to the next section or download them from the Internet.

In addition, there are a number of drivers available that will support various environments.

Windows 95 print driver with documentation	Part No. 100-9167
Windows NT 4.0 print driver with documentation	Part No. 100-9170
OPOS drivers with documentation	Part No. 100-9732
MICR Option Programmer's Guide	Part No. 100-9094
Master character set definitions	Part No. 100-9785

1.2.4 Contacting Ithaca Peripherals

The Sales and Field Engineering Departments will be able to help you with most of your questions.

Contact the Sales Department to receive technical support, order documentation, receive additional information about the Series 90PLUS printer, order supplies, or obtain information about other products by Ithaca Peripherals.

Contact the Field Engineering Department if you would like information about your warranty or if you need to send a printer in for service.

You can reach both the Sales and Field Engineering Departments at the following address and phone or fax numbers:

Ithaca Peripherals
20 Bomax Drive
Ithaca, NY 14850

Main phone	(607) 257-8901
Main fax	(607) 257-8922
Sales/Field Engineering fax	(607) 257-3868

1.2.4.1 Internet Support

Ithaca Peripherals maintains an Internet website. The address is http://www.ithper.com. On the technical support page, you can find support information on all of our printers. The Model 90PLUS printer support pages offer the latest information. They include the latest version of this manual; program examples; test procedures; programming instructions; and all supported print drivers.

2 General Descriptions

2.1 Series 90PLUS Models

There are four basic models of the Series 90PLUS printer. They are:

Model 91PLUS	RECEIPT PRINTER;
Model 92PLUS	RECEIPT/JOURNAL PRINTER;
Model 93PLUS	RECEIPT/JOURNAL/VALIDATION PRINTER; and
Model 94PLUS	RECEIPT/VALIDATION PRINTER.

2.2 Standard Features

The following features are common to the entire family of printers:

- 340 cps (M90PLUS) logic-seeking print speed
- 5 inches per second paper-feed speed
- 2.4 and 2.8 inch print zones
- Snap on ribbon cassettes
- Dual cash drawer drivers with status
- Centronics parallel, IEEE 1284 or serial RS232C interfaces
- Configurable receiver buffers
- Standard and Epson command emulations[1]
- Standard APA or EPOS bit-image graphics
- Standard and EPOS International Character Sets
- 8, 10, 12, 15, 17.1, 20, and 24 characters per inch selections
- Custom logo graphic print buffer in nonvolatile memory
- Emphasized, enhanced, double-wide, double-high, double-wide double-high, half-high, underline, subscript, superscript, and rotated printing
- Operator-visible print zones
- Self-diagnostics
- Setup and configuration utility programs
- Operator’s manual

2.3 Receipt Printer

The Model 91PLUS receipt printer only provides receipt functions. The last line printed on the receipt is within 0.7 inch of the tear-off or cut-off edge of the receipt. The receipt printing appears right-side up with the total at the bottom as the receipt appears from the top of the printer and is presented to the operator.

The receipt printer handles one-, two-, or three-ply paper. The optional cutter is able to cut one- and two-ply paper.

[1] Other emulation’s can be made available. Contact Ithaca Peripherals’ Sales Department for more information.

The recipt printer does not have the ability to validate or handle slips. Commands that operate validation and slip modes of other Series 90PLUS printers will not function.

2.4 Receipt/Journal Printer

The Model 92PLUS receipt/journal printer adds the journal feature to the Model 91PLUS receipt printer. The journal take-up is able to rewind the second copy of the 3.5-inch diameter 2-ply paper roll (125 feet).

The receipt/journal printer does not have the ability to validate or handle slips. Commands that operate validation and slip modes of other Series 90PLUS printers will not function.

2.5 Receipt/Journal/Validation Printer

The Model 93PLUS printer adds an independent validation capability to the Model 92PLUS. There are two methods of form validation on the Model 93PLUS.

1. Top insertion validation. The form is inserted from the top and extends out the left side and/or top of the printer. It rests on a fixed form stop. Under software control, printing can be from a minimum of two lines to a maximum of 17 lines at 42 characters. Throughout this manual, top insertion will be termed “Validation Mode”.

2. Front inserted forms. The form is inserted from the front and extends out the left side and/or front of the printer. In front insertion mode, the form is loaded to the first line of print under firmware control. Printing then begins from the top of the form down. Throughout this manual, front insertion will be termed “Slip Mode”.

All Series 90PLUS validation printers have both validation and slip modes. The validation/slip movement is independently controlled from the movement of the receipt and journal. Either can be moved alone or in sync with the receipt/journal movement. The validation/slip movement will be under software control but set to independent validation by default.

2.6 Receipt/Validation Printer

The Model 94PLUS receipt/validation printer adds validation, as described above in the Model 91PLUS. The Model 94PLUS is a Model 93PLUS without journal take-up.

3 General Specifications

3.1 Printing Specifications

Printing method	impact dot matrix
Head wire arrangement	9 pins in a line
Print wire diameter	0.34 mm (0.012 inch)
Print wire pitch	0.353 mm (0.013 inch)
Printing directions	bidirectional, logic-seeking
Print zone	59.5 mm (2.4 inches) or 71.12 mm (2.83 inches)
Characters per second (cps)	Refer to Table 1.
Characters per line (cpl)	Refer to Table 1.
Characters per inch (cpi)	Refer to Table 1.

Print Pitch Capability (in characters per inch)	Normal 2.8" Maximim Characters per Line	Narrow 2.4" Maximum Characters per Line	M90PLUS Characters per Second	M90PLUS Characters per Second
8	22	19	200	220
10	28	24	270	275
12	34	28	300	330
15	42	36	300	340
17.1 (condensed)	48	41 (40 in M50 mode)	300	340
20 (super-condensed)	56	48	300	340
24 (super-condensed)	68	57	300	340
5 (double-wide)	14	12	130	130
6 (double-wide)	17	14	150	160
7.5 (double-wide)	21	18	150	170
8.5 (condensed, double-wide)	24	20	150	170
10 (condensed, double-wide)	28	24	150	170
12 (super-condensed, double-wide)	34	28	150	170

Table 1 Character specifications

3.1.1 Character Generation

All the character sets and modes are based on one of two character cells, 10 wide x 9 high or 12 wide x 9 high. Double-wide mode is twice the width of the normal mode, 20 wide x 9 high or 24 wide x 9 high.

In utility print mode, the character cell consists of five full-dots and five half-dots horizontally by nine full-dots vertically. The character is a 9 x 9 character. In high-speed draft (HSD) mode, the character cell is shortened by one half-dot and one full-dot column yielding a 7 x 9 character.

Each character is justified to the left of the cell. The first four columns of the full dots and the first three columns of half dots are used to generate the character in high-speed draft. In utility mode, the first five

columns of the full dots and the first four columns of the half dots are used. The last full-dot and the last two half-dots are used for character spacing in both modes.

The following illustration shows a single-wide character cell.

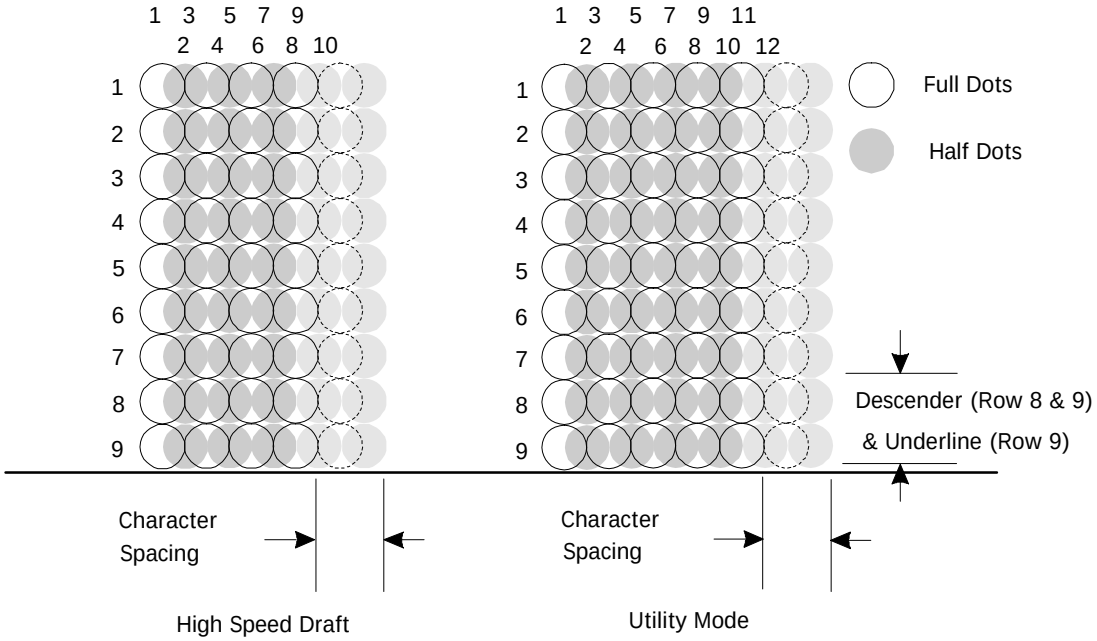


Figure 1 Single-wide character

The example above, which only holds true for the 12 cpi mode, shows full dots adjacent to each other in the character cell. The 10 cpi mode allows a gap between adjacent full rows; 17 and 24 cpi allow an overlap of full rows. The printer cannot print adjacent full and half dots in any single row. Some graphics (double-density, half-speed) allow adjacent rows to be printed by slowing the print speed by half. Slowing the print speed allows the time between half and full columns to be the same as the time between full columns in full speed operation.

The following illustration shows the use of full and half dots as well as descenders to form characters.

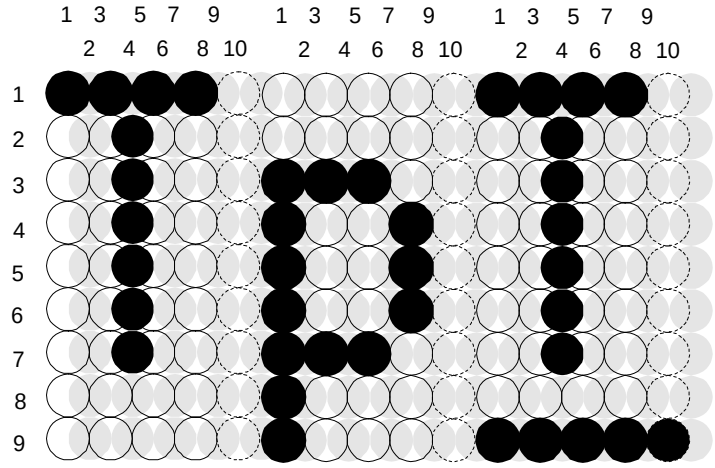


Figure 2 Character forming

3.2 Physical Specifications

3.2.1 Dimensions

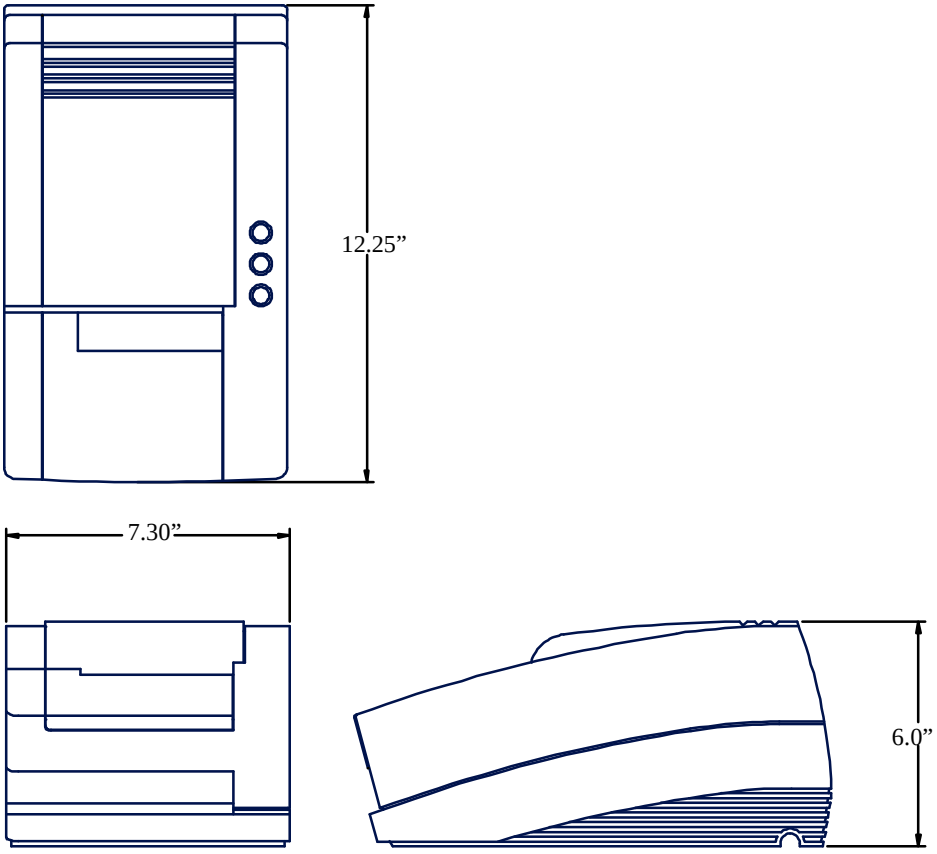


Figure 3 Physical dimensions

3.2.2 Weight

Approximate weight	10 pounds
Shipping weight	13 pounds

3.3 Electrical Characteristics

3.3.1 Self-powered AC

The Model 90PLUS printer is designed to be AC self-powered in domestic and international markets. The printer is equipped with a universal input power supply that is designed to operate worldwide without modification.

Supply Voltage Rating (VAC)	Supply Voltage Range (VAC)	Frequency (Hz)	Rated Power (watts)	Current Idle (amps)	Current Printing (amps)
100 - 240	90 - 264	47 - 63	45	0.08 @ 120VAC 0.04 @ 240VAC	0.5 @ 120VAC 0.25 @ 240VAC

Table 2 Power input requirements

3.3.2 Interface Specifications

3.3.2.1 Serial

The serial interface is a standard RS232 interface on a 9-pin, D-shell connector. It is defined as a standard DTE device. A null modem cable is required to interface the printer to another DTE device (a personal computer). See the serial port description later in this manual.

3.3.2.2 Parallel

The parallel port is a standard 25-pin, D-shell as defined in the IEEE 1284-A Standard. See the parallel port description later in this manual.

3.3.2.3 Cash Drawer

The M90PLUS printer supports dual cash drawers with status. The interface will provide status and 24 VDC at up to 1.5 amps to the cash drawer. See the cash drawer interface description later in this manual.

3.4 Media Specifications

3.4.1 Ribbon

Inking method	cartridge type, 1.8 m seamless ribbon with reinker
Ink color	black or purple
Ribbon life at 25˚C	3 million (black) or 4.5 million (purple) characters to ink depletion[2]
Manufacturer	Only Ithaca Peripherals approved ribbons should be used.

3.4.2 Receipt Paper

Paper-feed method	friction feed
Paper-feed pitch	default, 1/8 inch; can be set in units of 1/216 inch by software command
Paper width	2.5, 3.0, or 3.25 inches
Roll diameter	3.5 inches
Paper thickness	0.003 - 0.0035 inch at 25˚C
Roll paper core	inside diameter 7/16 inch or more

[2] Ribbon must be from an approved manufacturer and tested with a rolling ASCII test pattern using 15 cpi in HSD mode.

Roll footage	240 feet typical
Paper-low indicator	striping starts at approximately 8 - 10 feet from the end of the roll
Receipt-paper out	Paper exhaust is sensed, and printing is prevented at the end of the roll.

3.4.3 Receipt/Journal Paper

Paper-feed method	friction feed
Paper-feed pitch	default, 1/8 inch; can be set in units of 1/216 inch by software command
Paper width	2.5, 3.0, or 3.25 inches
Roll diameter	3.5 inches
Paper thickness	0.006 - 0.007 inch two-ply at 25˚C; 0.009 - 0.0105 inch three-ply at 25˚C
Roll paper core	inside diameter, 7/16 inch
Roll footage	110 feet typical (two-ply); 70 feet typical (three-ply)
Paper-low indicator	striping starts at approximately 8 - 10 feet from the end of the roll
Receipt-paper low	The paper level is sensed by software with an adjustable end of roll monitor that prevents printing.

3.4.4 Inserted Slips and Forms

Paper width	2.50 to 9.0 inches
Length	3.375 to 11.0 inches
Paper thickness	a. one sheet: 0.0035 to 0.016 inches at 25˚C b. combination of copy paper and carbon-copy paper: 4 sheets maximum (one original and three copies) c. maximum form thickness: 0.016 inches at 25˚C

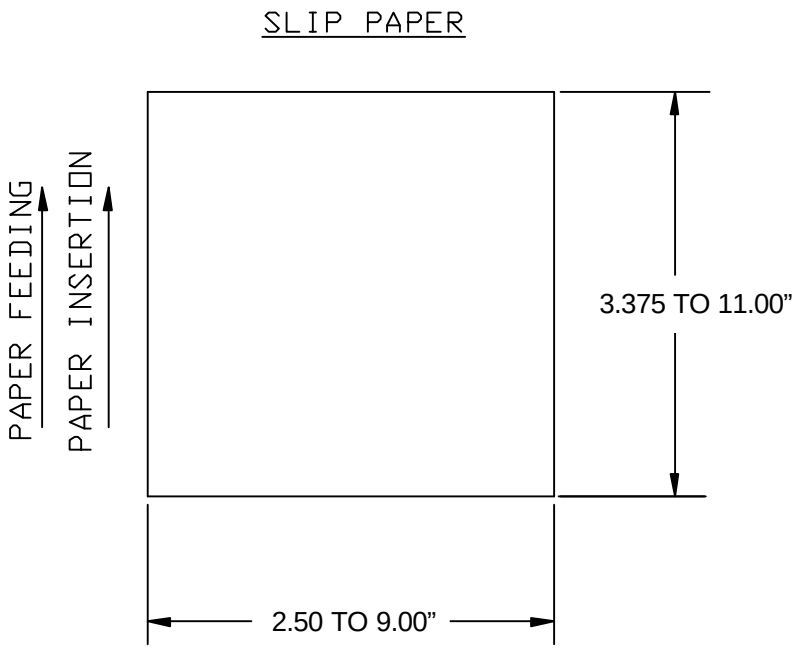


Figure 4 Slip-form size

3.5 Slip Sensor

Once an inserted form has been properly aligned and sensed by the slip sensor, it is positioned at the top of the form by the slip-load command.

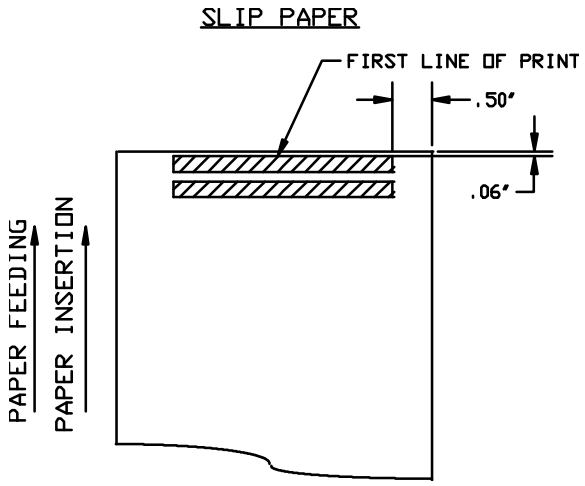


Figure 5 Slip-paper print

The position of the first line of print can be adjusted by ± 0.050 inch during printer installation.

3.6 Printable Area

3.6.1 Receipt Printing

3.6.1.1 Receipt Printing Without the Autocutter

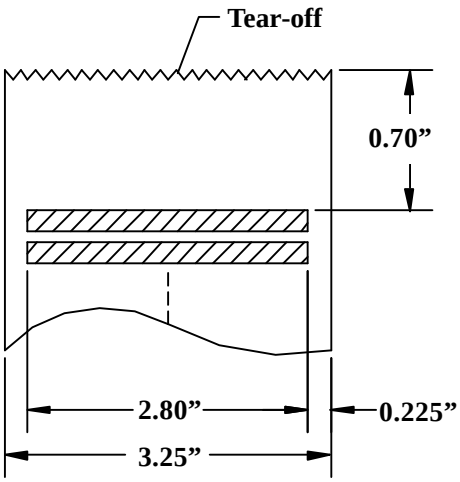


Figure 6 Receipt printable area

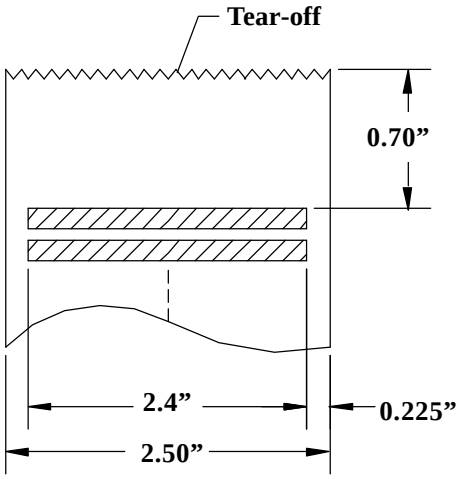


Figure 7 Receipt printable area

The paper tear-off is 0.7 inch above the last line of print. To place the last line printed above the tear-off point, the paper should be fed 0.8 inch. The paper can then be torn-off from either the left or right side. The first line of the next print will be 0.7 inch from the top of the form.

The paper should not be reverse fed back into the printer. If a double-high line of print is the first line of a receipt, it will be reverse fed 0.1 inch. If any more paper is reverse fed, the paper will become unloaded from the tear-off.

3.6.1.2 Receipt Printing with the Autocutter

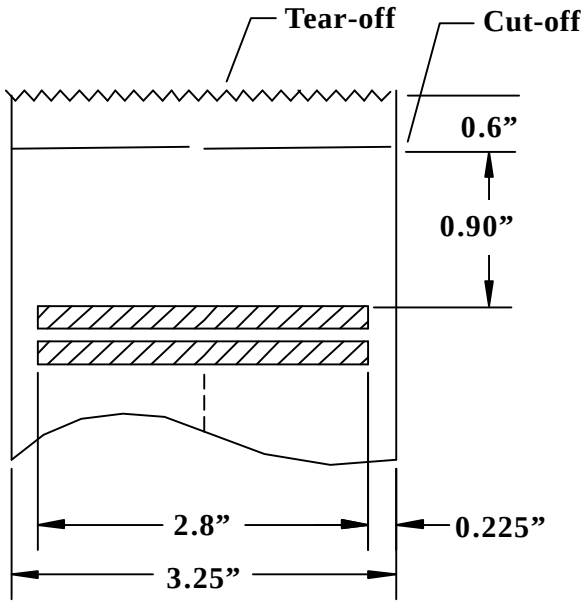


Figure 8 Receipt autocutter position

The autocutter has a cut point and a tear-off point. The tear-off is used to separate the partial cut cleanly from the next receipt.

The autocutter is positioned 0.9 inch from the top of the last line of print to the cut point. The paper should be fed 1.0 inch after the last line is printed and before the cutter is activated. After the cut, the paper will automatically be fed 0.6 inch to allow the receipt cut point to be at the tear-off point.

The first line of print will then be 1.5 inches from the cut. If the first line of the next receipt is to be closer to the top of the receipt, the receipt can be reversed up to 0.4 inch. The previous receipt must, however, be removed before the reverse feed. If the receipt is not to be removed but is to remain attached to the next receipt, the paper should not be reversed.

The paper should not be fed back into the printer more than 0.4 inch. If a double-high line of print is the first line of a receipt, it will be reverse fed 0.1 inch. If any more paper is reverse fed, the paper will become unloaded from the knife.

3.6.2 Validation Forms Printing

The Models 93PLUS and 94PLUS are both equipped with independent validation. The movement of the validation form is under software or firmware control and allows the form to move either independent of the receipt (or receipt/journal) or in sync with the receipt (or receipt/journal).

Lines per inch	Lines
9	18
8.5	17
8	16
6	13

Table 3 Validation lines

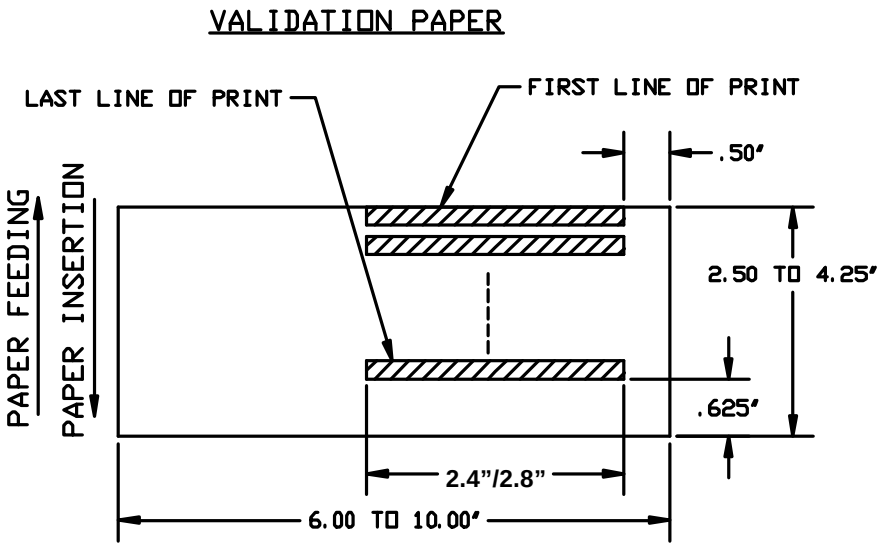


Figure 9 Validation print with normal and narrow print zones

3.6.2.1 Validation Forms Insertion

Form insertion is from the top or the left side of the printer. Automatic form location is under software or firmware control. Character rotation under software control will allow check validation to appear right-side up when the check is removed.

3.6.3 Inserted Forms Printing

Top of form to top of print line	0.625 inch
Minimum form length	3.375 inches
Minimum form width	2.5 inches
Bottom of form to bottom wire	0.625 inch

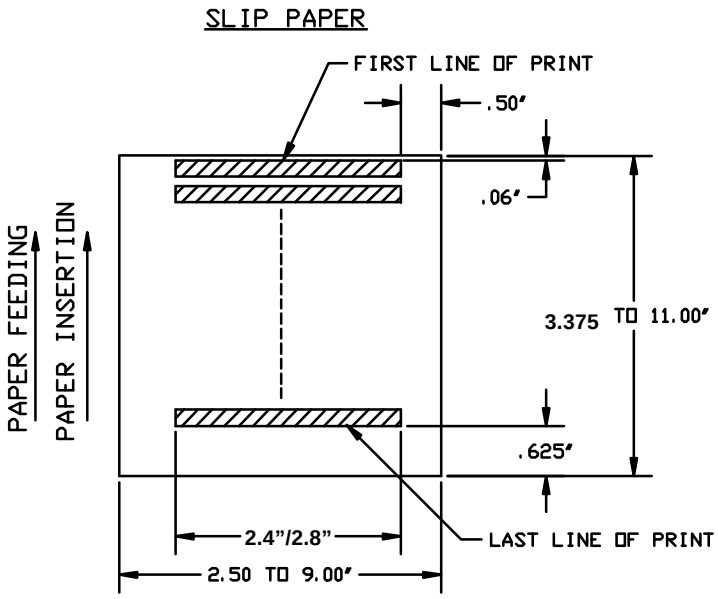


Figure 10 Inserted slip using normal and narrow print zone

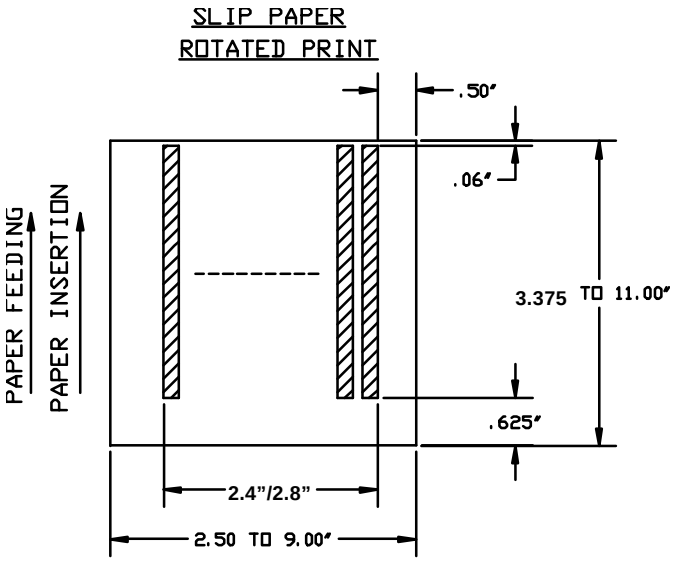


Figure 11 Normal and narrow print zone rotated print

3.6.3.1 Inserted Forms Guidelines

- Use forms with a paper roll loaded.
- Use forms that are flat and without curls, folds, warps, or wrinkles.
- Glue should not be on the bottom edge of the form.
- Use of multipart forms with thick middle plies will decrease copy visibility.

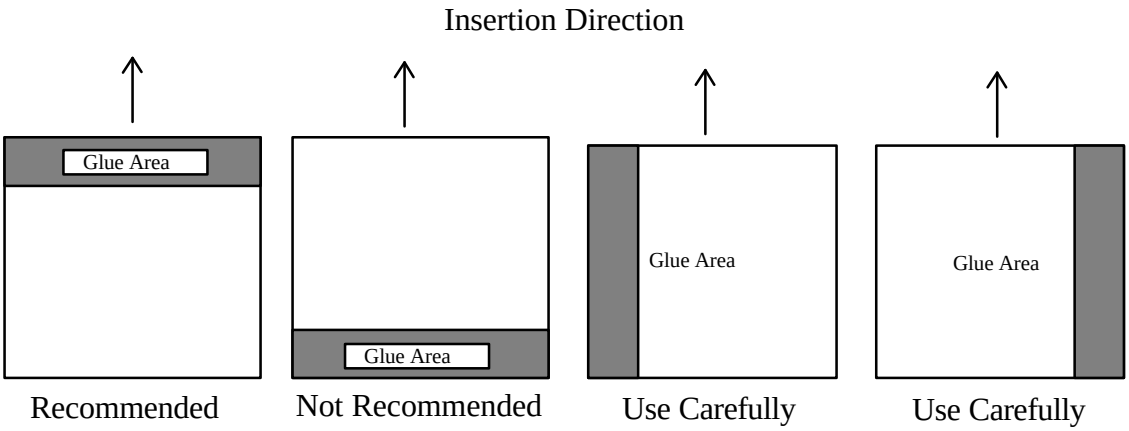


Figure 12 Multipart forms

3.6.4 MICR Reader

The MICR reader is an option for the M90PLUS printer. It is attached to the front of the printer and allows a document having MICR data on it to be read and positioned for print.

The MICR reader recognizes the magnetic ink on the bottom of checks; it is not an optical reader. Any nonmagnetic data will not be read. The M90PLUS MICR reader is based on a technique which uses a magnetic read head to pick up a signal from a document containing magnetic ink which is passed beneath the read head.

The M90PLUS MICR reader recognizes E13-B characters. It does not read CMC-7 characters. CMC-7 characters are used in Latin America and Europe.

4 Control Codes Overview

The programmer's guide is designed to help users of the Series 90PLUS slip printer develop applications. The Series 90PLUS printers are specialized, point-of-sale printers that have several features not normally found on general purpose printers. Because of these special features, the Series 90PLUS printers have specialized control codes. This manual documents all of the control codes with an emphasis on those codes that are unique to the Series 90PLUS printer.

All PcOS Series 90PLUS printers have both a serial and parallel interface. Both interfaces provide the same printer control[3] and use the same codes.

4.1 Nomenclature

When describing control codes, there is often confusion as to whether the description is decimal, hex, or ASCII. To minimize the confusion, this book will use the following nomenclature when describing control code sequences:

[ ]	encloses a control character. This is a single, 8-bit value as defined in the standard ASCII tables. The ASCII chart in Appendix A lists all of the control codes. An example would be [ESC], which would represent a 1BH or 26 decimal.
< >	encloses an 8-bit value in decimal format. The value will be from 0 to 255. An example would be <2>, which would represent 02H or 2 decimal.
<n>	indicates a variable parameter. <n> can have a value from 0 to 255. The meaning of <n> is described and defined in the description of the command.
<n_1> <n_2>	indicates that there are two parameters, n_1 and n_2, where both can have values from 0 to 255.
<m_1> <m_2>	is an IPCL parameter consisting of two digits where m_1 and m_2 are ASCII characters from 0 to 9. The parameter will be combined to form a value from 0 to 99. If m_3 is included, the parameter will be combined to form a value from 0 to 999. If two values are specified, there must be two bytes added to the IPCL code. That is if the command specifies <m_1> <m_2> and the desired value is 5, the value must be specified as 05.
x	represents all other ASCII characters in control strings. For example, [ESC] 1 would represent 1BH followed by 31H.

The CFG90 configuration and demonstration program[4] uses the same nomenclature. All print examples shown in this manual are available for CFG90.

In many cases, applications require that control sequences be specified in hex or decimal codes. In most cases, commands are specified in ASCII, hex, and decimal. There is an ASCII chart in Appendix A that lists ASCII, hex, and decimal equivalents.

[3]The serial and parallel, IEEE 1284 interfaces provide a few additional interface capabilities over the standard parallel interface. Both serial and parallel, IEEE 1284 interfaces provide a bidirectional data path.

[4]CFG90 is available from Ithaca Peripherals at no cost. This program runs on IBM personal computers and compatibles.

4.1.1 Standard Emulation

The standard control codes for the Series 90PLUS printer are extensions and subsets of the IBM emulation provided on other PcOS products. In some cases, an application designed for a Series 50 printer with IBM code sets will function with a Series 90PLUS printer. There are, however, significant differences in the operation of the Series 90PLUS printer that may impact existing applications.

4.1.2 EPOS Emulation

ESC/POS[5] is referred to here as EPOS. The Series 90PLUS printer supports an EPOS emulation with extensions. The emulation is designed to allow the Series 90PLUS printer to be used with applications that are designed for Seiko Epson printers. It is intended that the standard emulation be used for new applications. Not all features of the Series 90PLUS printer are supported by EPOS.

This manual will include the EPOS code equivalent for features of the Series 90PLUS printer that are supported by EPOS. When EPOS commands are significantly different from the standard emulation, an independent EPOS description is provided.

4.1.3 IPCL Codes

IPCL (Ithaca Printer Control Language) codes are designed to control a printer without using control characters, i.e., characters less than 20H. Only the standard emulation supports IPCL. Not all commands are supported by IPCL codes. For those command that are supported, the IPCL code is listed.

In rare cases, an IPCL code will interfere with the text that is to be printed. The IPCL translator can be disabled with an [ESC]y<4> command.

4.2 Application Development

To aid in application development, there are several sections in this manual that are designed to help the programmer understand the Series 90PLUS printer. The first is a detailed description of each of the commands. The second section is an explanation of how the printer works. It explains the internal print buffer, the communication link, and how the host computer and printer interact. The third is a description on how to use the CFG90 program to help develop applications.

4.3 Tables and Charts

Throughout this guide, there are charts and tables that list commands and features. In most cases, these charts cross-reference the page that describes the command. Commands are grouped by function and can at times be hard to find. To minimize the time it takes to find commands, there are two code summary charts in the following section, one ordered by code and one by function.

[5] ESC/POS is a registered trademark of the Seiko Epson Corporation.

5 Printer Control Codes

5.1 Print/Paper Motion

5.1.1 Low-level Paper Motion Control

Function	**Carriage return**
ASCII	[CR]
Hexadecimal	0DH
Decimal	<13>
IPCL	&%CR
EPOS	0DH
Description	The command prints the contents of the print buffer (if any) and resets the next character print position to the left margin. A linefeed is not performed unless autofeed was activated. The left margin is defined by the current print station, the print rotation direction, and the left margin command.
Note	In single line mode, the [CR] is used to terminate all lines. The printer will go busy[6] after the [CR] is received. The printer will not be ready to accept data until the previous data is printed.

Function	**Linefeed**
ASCII	[LF]
Hexadecimal	0AH
Decimal	<10>
IPCL	&%LF
EPOS	0AH
Description	The command prints the contents of the buffer (if any) and advances the paper one line at the current default line spacing. The next character print position is not reset to the left margin unless auto-CR was active.

5.1.2 Horizontal Motion Control

There are several commands that can control the horizontal position of the characters. Many applications use space control to position fields. However, there is the ability to control character position with horizontal tab stops. To move tabs, use the horizontal tab, [HT].

6 In one-line mode, the parallel -ort busy signal will occur as a result of receiving the [CR].

In serial mode, the busy indication will be delayed until the [CR] is processed by the input software. Data sent to the printer after the [CR] will not be lost unless the printer is power-cycled.

Function	**Horizontal tab**
ASCII	[HT]
Hexadecimal	09H
Decimal	<9>
IPCL	&%HT
EPOS	[HT]
Description	The command inserts spaces in the print buffer up to the next tab stop. The default tab locations are every eight spaces.

Function	**Back space**
ASCII	[BS]
Hexadecimal	08H
Decimal	<8>
IPCL	&%BS
EPOS	[BS]
Description	The command prints the data in the print buffer and shifts the current horizontal position by one character width to the left. If the current position is at the left margin, the [BS] is ignored.

Function	**Set horizontal tab stops**
ASCII	[ESC] D $<n_1>$ $<n_2>$ $<n_3>$ ... $<n_i>$ 0
Hexadecimal	1BH 44H $<n_1>$ $<n_2>$ $<n_3>$ ... $<n_i>$ 00H
Decimal	<27><68>$<n_1>$ $<n_2>$ $<n_3>$ ... $<n_i>$ <0>
IPCL	none
EPOS	[ESC] D$<n_1>$ $<n_2>$ $<n_3>$ ... $<n_i>$ 0
Description	The command sets tab stops at the character columns specified by <n>. The end of the setting is specified by a <0>. All previously set tabs will be cleared by the command. There is no default restore procedure other than to respecify the tabs. Column sizes are in accordance with the current character pitch. Setting tabs that are beyond the station width is possible. A [CR] will be inserted if the tab is used. Printing will begin at the home position. The power up default is every eight spaces, i.e., 9, 17, 25, and so forth.

Function	**Reset horizontal and vertical tab stops**
ASCII	[ESC] R
Hexadecimal	1BH 52H
Decimal	<27><82>
IPCL	&%HV
EPOS	none
Description	The command resets horizontal and vertical tab stops to power up configuration. The power up horizontal default is every eight spaces, i.e., 9, 17, 25, and so forth. The vertical default is every line.

Function **Set justification**

ASCII [ESC] a <n>

Hexadecimal 1BH 61H <n>

Decimal <27><97><n>

IPCL &%JL, &%JC, &%JR

EPOS [ESC] a <n>

Description The command sets the horizontal justification.

Where <n>:			
	0	left justified	&%JL
	1	center justified	&%JC
	2	right justified	&%JR
	8	left justified (no LF)	none
	9	center justified (no LF)	none
	10	right justified (no LF)	none

The print format can be right, center, or left justified. The value of <n> specifies the justification.

The power on default is left justified.

Notes

1. Lines that have mixed size characters within the line cannot be centered. For example, a line with mixed single- and double-high text cannot be centered. If a line of print is to be double-high and centered, the change to single-high print must be done after the line terminator for the double-high line.

   For example, [ESC]W<3>Centered[ESC]W<0>[CR] will not print correctly because the printer assumes that more data will follow the [ESC]W<0>. The correct line would be: [ESC]W<3>Centered[CR] [ESC]W<0>.
2. The justify commands do not effect graphics.

5.2 Vertical Motion Control

Function	**Fine linefeed**
ASCII	[ESC] J <n>
Hexadecimal	1BH 4AH <n>
Decimal	<27> <74><n>
IPCL	&%FM <m_1> <m_2> <m_3>
EPOS	[ESC] J <n>
Description	The function command prints the contents of the buffer (if any) and performs a linefeed of n/216 inch. The command does not change the default line spacing value. The next character print position is reset to the left margin if the auto-CR mode is set.
EPOS Note	In EPOS mode, the command performs linefeeds in n/144 inch increments.

```
Example of Fine Line Feed[CR]
[ESC]J<54>
This line is 1/4" below the first. [CR][LF]
This line is spaced at the default
of 1/8". [CR][LF]
```

Data sent to printer

```
Example of Fine Line Feed

This line is 1/4" below the first.
This line is spaced at the default of 1/8".
```

Resulting print

Function	**Set variable line space n/216 inch**
ASCII	[ESC] 3 <n>
Hexadecimal	1BH 33H <n>
Decimal	<27><51><n>
IPCL	&%SV <m_1> <m_2><m_3>
EPOS	[ESC] 3 <n>
Description	The command sets the default line spacing to n/216 inch. Set n = 1 to 255. The command takes effect immediately and sets the linefeed spacing used by [LF] to values other than 1/8 or 7/72 inch.
EPOS Note	Line spacing of n/144 inch is used.

Function	**Set line space 27/216 inch**
ASCII	[ESC] 0
Hexadecimal	1BH 30H
Decimal	<27><48>
IPCL	&%ST
EPOS	[ESC] 2
Description	The command sets the default line spacing to 1/8 or 27/216 inch, which is the standard eight lines per inch line spacing at initial power up.
EPOS Note	In EPOS mode, the command sets 1/6 inch spacing or six lines per inch.

Function	**Set line space 21/216 or 7/72 inch**
ASCII	[ESC] 1
Hexadecimal	1BH 31H
Decimal	<27><49>
IPCL	&%SG
EPOS	none
Description	The command sets the default line spacing to 21/216 inch. The line spacing is for All Points Addressable (APA) graphic printing.

Function	**Set variable line space n/72 inch**
ASCII	[ESC] A <n>
Hexadecimal	1BH 41H <n>
Decimal	<27><65><n>
IPCL	none
EPOS	none
Description	The command sets the default line spacing to n/72. Set n = 1 to 85. The line spacing does not take effect until enabled by the [ESC] 2 command. The command is provided to maintain backward compatibility with the Series 50, OKIDATA, IBM, and other printers. It can also be used to print on preprinted forms.

Function	**Enable [ESC] A <n> line spacing**
ASCII	[ESC] 2
Hexadecimal	1BH 32H
Decimal	<27><50>
IPCL	none
EPOS	none
Description	[ESC] 2 enables [ESC] A <n> line spacing. [ESC]2 is a companion to the [ESC] A <n> command and puts the specified line spacing into effect. It will remain in effect until another line spacing command is issued.

Function	**Feed <n> lines at current spacing**
ASCII	[ESC] d <n>
Hexadecimal	1BH 64H <n>
Decimal	<27><100> <n>
IPCL	&%FL <m_1> <m_2>
EPOS	[ESC] d
Description	The command prints the contents of the buffer (if any) and performs <n> linefeeds at the current line spacing. The command does not change the default line spacing value. The next character print position is reset to the left margin.
Note	The IPCL command will print from 00 to 99 lines. For example, if you wish to feed 12 lines, the IPCL command would be as follows: &%FD12.

Function	**Vertical tab**
ASCII	[VT]
Hexadecimal	0BH
Decimal	<11>
IPCL	&%VT
EPOS	(VT)
Description	The printer sets a line counter to the top of the form whenever a station is selected. By setting vertical tab stops, various form positions can be reached with a [VT] operation.

Function	**Set vertical tab stops**
ASCII	[ESC] B <n_1> <n_2> <n_3> ... <n_i> 0
Hexadecimal	1BH 42H <n_1> <n_2> <n_3> ... <n_i> 00H
Decimal	<27><66><n_1> <n_2> <n_3> ... <n_i> <0>
IPCL	none
EPOS	[ESC] B <n_1> <n_2> <n_3> ... <n_i> 0
Description	The command sets tab stops at line positions specified by <n>. The end of the setting is specified by a <0>. All previously set tabs will be cleared by the command. There can be a total of 64 tab stops specified by the command; however, the power on default is a tab stop on every line.

Function	**Reset horizontal and vertical tab stops**
ASCII	[ESC] R
Hexadecimal	1BH 52H
Decimal	<27><82>
IPCL	&%HV
EPOS	none
Description	The command resets horizontal and vertical tab stops to power up configuration. The power up horizontal default is every eight spaces, i.e., 9, 17, 25, and so forth. The vertical default is every line.

Function	**Form feed**
ASCII	[FF]
Hexadecimal	0CH
Decimal	<12>
IPCL	&%FF
EPOS	none
Description	The command performs a form feed to the top of the form.

Function	**Set top of form**
ASCII	[ESC] 4
Hexadecimal	1BH, 34H
Decimal	<27> <52>
IPCL	&%TF
EPOS	[ESC]L
Description	The command sets the top of the form to the current position.

Function	**Set form length in lines**
ASCII	[ESC] C <n>
Hexadecimal	1BH, 43H <n>
Decimal	<27> <67> <n>
IPCL	&%SL<m_1> <m_2>
EPOS	[ESC]C<n>
Description	The command sets the form length to <n> lines at the current line spacing.

Function	**Set form length in inches**
ASCII	[ESC] C [NUL] <n>
Hexadecimal	1BH, 43H <0> <n>
Decimal	<27> <67> <0> <n>
IPCL	&%SI <m_1> <m_2>
EPOS	none
Description	The command sets the form length to <n> inches.

Function	**Begin automatic linefeed**
ASCII	[ESC] 5 <01>
Hexadecimal	1BH 35H 01h
Decimal	<27><53><01>
IPCL	&%MA
EPOS	none
Description	The command sets automatic linefeed mode which overrides the configuration setting.

Function	**End automatic linefeed**
ASCII	[ESC] 5 <0>
Hexadecimal	1BH 35H 00H
Decimal	<27><53><0>
IPCL	&%CA
EPOS	none
Description	The command ends automatic linefeed mode which overrides the configuration setting.

Function	**Reverse linefeed**
ASCII	[ESC]]
Hexadecimal	1BH 5DH
Decimal	<27><93>
IPCL	&%LR
EPOS	none
Description	The command performs a reverse linefeed at the current line spacing.
Notes	1. The receipt station can tolerate no more than 1/2 inch of reverse feed. 2. In validation mode, the form cannot be reversed past the first line of validation. 3. In slip mode, the form should not be reversed past the first line of the slip.

5.3 Character Font

Function	**Begin High Speed Draft (HSD) mode**
ASCII	[ESC] # <0>
Hexadecimal	1BH 23H 00H
Decimal	<27><35><0>
IPCL	&%QT
EPOS	[ESC] ! <n>
Description	The command begins high speed draft print mode (one pass, 7 x 7 font). Enhanced, emphasized, subscript, superscript, and underline character attributes are not available in HSD mode. To maintain optimum print speed, the printer should be returned to HSD mode when enhanced print is not required.

Function	**Select print quality mode**	
ASCII	[ESC] I <n>	
Hexadecimal	1BH 49H 00H	
Decimal	<27><73><0>	
IPCL	&%QT	High Speed Draft (HSD)
	&%QU	Utility
	&%QL	Near-letter-quality (NLQ) Courier
	&%QS	Near-letter-quality (NLQ) Sans Serif
EPOS	[ESC] x <n> and/or [ESC] ! <n>	
Description	The command begins Utility or NLQ print mode.	
	Where n:	0 HSD
		1 Utility
		2 NLQ Courier
		3 NLQ Sans Serif
		4 - 7 Will repeat 0 - 3
	Utility mode is a one pass, 9 x 7 font. Utility print mode enables enhanced, emphasized, subscript, superscript, and underline character attributes. Print speed is reduced approximately 20 percent over the HSD mode.	
	NLQ Courier and Sans Serif print modes are two pass, 9 x 7 fonts. The print speed is reduced and character features are added to the font to enhance the appearance.	
EPOS Note	[ESC] x < is identical to [ESC] I in normal mode. [ESC]!<n> performs a similar function; however, NLQ is not available.	

Where n-bits:	76543210 function
1- - - - - - -	underline
- - 1- - - - -	double-wide
- - - 1- - - -	double-high
- - - - - - - X	font: 1 = Utility mode; 0 = HSD mode

Function	**Begin 90˚ or 270˚ rotated font**
ASCII	[ESC] P <n>
Hexadecimal	1BH 50H n
Decimal	<27><80><n>
IPCL	&%RI {n=2},&%RF{n=1},&%RN{n=0}
EPOS	[ESC]V<n>
Description	The command sets the print font to a rotated 90˚ or 270˚ font.

Where n:

0	normal	
1	rotate 90˚	7 x 9 font
2	rotate 270˚	7 x 9 font
5	rotate 90˚	5 x 7 font
6	rotate 270˚	5 x 7 font

The rotated print font is a one pass, 7 x 9 or 5 x 7 font. Enhanced, emphasized, subscript, superscript, and underline character attributes are not available in 90˚ or 270˚ rotated font mode. Double-wide and double-high are available. However, because the font is rotated, double-wide will make the characters taller and double-high will make the characters wider.

The current pitch sets the spacing between lines. If eight cpi are set, the printer will produce the equivalent of eight lines per inch rotated print.

Print pitches greater than 15 cpi are very small and difficult to read. The rotated font mode prints faster than the formatted rotated print mode. However, there is no formatting in 90˚ or 270˚ rotated font mode.

Note	Line graphic characters (<176> to <223>) print unrotated.
EPOS Note	In EPOS mode if <n> = 0, rotation is turned off. If <n> = 1, the pitch is set to 10 cpi. If <n> = 2, the cpi is set to eight.

Function	**End 90˚ rotated font**
ASCII	[ESC] P <0>
Hexadecimal	1BH 50H 0H
Decimal	<27><80><0>
IPCL	&%RN
EPOS	[ESC]V<n>
Description	The command returns the print font to normal nonrotated mode.
Note	The command leaves the printer in utility print mode.

5.4 International Character Sets and Code Pages

The Series 90PLUS printer supports 65 different international character sets. In IBM and EPOS printers, there have historically been two ways of selecting a character set. The first mode substitutes international characters in the upper 128 characters of the standard character set. The technique supports a few different countries. As more and more countries were added, too many characters were being replaced, and it became a problem for the application to match the characters displayed and the characters printed. To solve these problems, code pages were developed. The printer and the display could use the same code page. The application would then display and print the same characters. IBM and EPOS defined new commands to select code pages and left the old commands in effect.

The Series 90PLUS printer supports international character sets as well as code pages. However, both methods are extended in the Series 90PLUS models to allow the most flexibility for the application programmer. In IBM mode, there are 19 character sets and 60 code pages. In EPOS, there are 57 character sets and 5 code pages[7].

The Series 90PLUS printer allows the IBM code page selection command to allow character sets as well as normal IBM code pages to be selected. The EPOS character set select command has been extended to allow additional character sets over and above the 11 defined by EPOS. The EPOS code page select command has not been extended as there is no EPOS definition beyond the first six ID's.

All characters in code pages as well as character sets are addressed as 0 to 255. (Characters below 32 must be addressed with the [ESC]^<n> command.) Code pages may be changed at any time and are active for all features including rotated print. To allow other code pages to be created by an application, a redefine character set command is provided. The command allows individual character substitutions.

As discussed above, there are two commands for language selection in IBM mode. The first is [ESC] ! which will select one of 19 international character sets. The command will not select all the possible sets and is provided for compatibility with older programs. The second is [ESC] [T which will select any of the 58 code pages. In EPOS mode, the command [ESC] R has been expanded and will select any of the 59 international character sets or code pages.

Function	**Select International Character Set**
ASCII	[ESC] ! <n>
Hexadecimal	1BH 21H
Decimal	<27><33>
IPCL	&%CS<n>
EPOS	[ESC] R <n>
Description	The command selects international character set, <n>. In standard mode, the value of <n> is as follows.

[7] Epson provides limited code page support through ID to code page translation. Only six translations are defined.

<n>	Language	<n>	Language	<n>	Language
64-'@'	ASCII (slashed zero)	71-'G'	Norwegian	78-'N'	Swedish IV
65-'A'	ASCII (unslashed zero)	72-'H'	Dutch	79-'O'	Turkish
66-'B'	British	73-'I'	Italian	80-'P'	Swiss I
67-'C'	German	74-'J'	French Canadian	81-'Q'	Swiss II
68-'D'	French	75-'K'	Spanish	90-'Z'	Publisher
69-'E'	Swedish	76-'L'	Swedish II		
70-'F'	Danish	77-'M'	Swedish III		

Table 4 Language table identification

Country Code/ Language Set	Epson ID	Country Code/ Language Set	Epson ID	Country Code/ Language Set	Epson ID
ASCII	0	Swiss II	20	Windows Greek	50
French	1	Cyrillic II-866	21	Latin 5 (Windows Turkey)	51
German	2	Polska Mazovia	22	Windows Cyrillic	52
British	3	ISO Latin 2	23	Hungarian CWI	54
Danish I	4	Serbo Croatic I	24	Kamenicky (MJK)	55
Swedish I	5	Serbo Croatic II	25	ISO Latin 4 (8859/4)	56
Italian	6	Multilingual	26	Turkey-857	57
Spanish I	7	Norway	27	Roman-8	58
Japanese	8	Portugal	28	Hebrew NC (862)	60
Norwegian	9	Turkey	29	Hebrew OC	61
Danish II	10	Greek 437	38	Windows Hebrew	62
Spanish II	11	Greek 928	39	KBL- Lithuanian	63
Latin American	12	Greek 437 CYPRUS	41	Publisher	64
French Canadian	13	ECMA-94	42	Ukrainian	66
Dutch	14	Canada French	43	ISO Latin 6 (8859/10)	67
Swedish II	15	Cyrillic I-855	44	Windows Baltic	68
Swedish III	16	Cyrillic II-866	45	Cyrillic-Latvian	69
Swedish IV	17	East Europe Latin II-852	46	Bulgarian	72
Turkish	18	Greek 869	47	Icelandic-861	73
Swiss I	19	Windows East Europe	49	Baltic 774	74

Table 5 EPOS language table identification

Note: there is a demonstration script distributed with the CFG90 program that will print a complete character chart for IBM or EPOS modes. See the CFG90 distribution disk.

Function **Select character code page**

ASCII [ESC] [T <n_h> <n_1>

Hexadecimal 1BH 5BH 54H <n_h> <n_1>

Decimal <27><91><84><n_h> <n_1>

IPCL &%CP <m_1> <m_2><m_3><m_4>

EPOS [ESC] t <n>

Description The command selects the character code page, <n_h> <n_1>. The Series 90PLUS printer supports many code pages. The following code pages are supported.

Code Page	Country Code/ Language Set	Decimal <n_h> <n_l>	Hex <n_h> <n_l>	Code Page	Country Code/ Language Set	Decimal <n_h> <n_l>	Hex <n_h> <n_l>
64	USA (Slashed 0)	0,64	0H,040H	869	Greek 869	3,101	3H,065H
65	USA(Unslashed 0)	0,65	0H,041H	874	Thailand	3,106	3H,06AH
66	British	0,66	0H,042H	895	Kamenicky (MJK)	3,127	3H,07FH
67	German	0,67	0H,043H	1008	Greek 437	3,240	3H,0F0H
68	French	0,68	0H,044H	1009	Greek 928	3,241	3H,0F1H
69	Swedish I	0,69	0H,045H	1011	Greek 437 CYPRUS	3,243	3H,0F3H
70	Danish	0,70	0H,046H	1012	Turkey	3,244	3H,0F4H
71	Norwegian	0,71	0H,047H	1013	Cyrillic II-866	3,245	3H,0F5H
72	Dutch	0,72	0H,048H	1014	Polska Mazovia	3,246	3H,0F6H
73	Italian	0,73	0H,049H	1015	ISO Latin 2	3,247	3H,0F7H
74	French Canadian	0,74	0H,04AH	1016	Serbo Croatic I	3,248	3H,0F8H
75	Spanish	0,75	0H,04BH	1017	Serbo Croatic II	3,249	3H,0F9H
76	Swedish II	0,76	0H,04CH	1018	ECMA-94	3,250	3H,0FAH
77	Swedish III	0,77	0H,04DH	1019	Windows East Europe	3,251	3H,0FBH
78	Swedish IV	0,78	0H,04EH	1020	Windows Greek	3,252	3H,0FCH
79	Turkish	0,79	0H,04FH	1021	Latin 5 (Windows Turkey)	3,253	3H,0FDH
80	Swiss I	0,80	0H,050H	1022	Windows Cyrillic	3,254	3H,0FEH
81	Swiss II	0,81	0H,051H	1024	Hungarian CWI	4,0	4H,000H
90	Publisher	0,90	0H,05AH	1026	ISO Latin 4 (8859/4)	4,2	4H,002H
91	Welsh	0,91	0H,05BH	1027	Ukrainian	4,3	4H,003H
437	USA	1,181	1H,0B5H	1028	Roman-8	4,4	4H,004H
774	Baltic 774	3,6	3H,006H	1029	ISO Latin 6 (8859/10)	4,5	4H,005H
850	Multilingual	3,82	3H,052H	1030	Hebrew NC (862)	4,6	4H,006H
852	East Europe Latin II-852	3,84	3H,054H	1031	Hebrew OC	4,7	4H,007H
855	Cyrillic I-855	3,87	3H,057H	1032	Windows Hebrew	4,8	4H.008H
857	Turkey 857	3,89	3H,059H	1033	KBL-Lithuanian	4,9	4H,009H
860	Portugal	3,92	3H,05CH	1034	Windows Baltic	4,10	4H,00AH
861	Icelandic-861	3,93	3H,05DH	1035	Cyrillic-Latvian	4,11	4H,00BH
862	Hebrew NC (862)	3,94	3H,05EH	1072	Bulgarian	4,48	4H,030H
863	Canada French	3,95	3H,05FH				
865	Norway	3,97	3H,061H				
866	Cyrillic II-866	3,98	3H,062H				

Table 6 Code page definition table

*Note: The code page field is a 16-bit field that is equivalent to the code page number. For example, 1 * 256 + 181 = 437. For the IPCL command, the page is specified in ASCII as a four-byte field.*

EPOS Note EPOS defines <n> as follows:

<n>	Character Code Page	<n>	Character Code Page
0	Code Page 437	3	Code Page 860
1	Not supported	4	Code Page 863
2	Code Page 850	5	Code Page 865

Table 7 EPOS code page definition table

Function	**Print control character**
ASCII	[ESC] ^ <n>
Hexadecimal	1BH 5EH <n>
Decimal	<27><94<n>
IPCL	&%CC <m_1><m_2><m_3>
EPOS	[ESC] ^ <n>
Description	The command allows characters from 0 to 31 codes to be printed. In normal operation, characters from 0 to 31 are control characters. The command turns off control code translation for the following character. <n> can be from 0 to 255.

Function	**Redefine character set**
ASCII	[ESC] [S <L_L> <L_H> <B_C> <T_{1L}><T_{1H}> <T_{2L}><T_{2H}> <T_{3L}><T_{3H}> … <T_{nL}><T_{nH}>
Hexadecimal	1BH 5BH 40H …
Decimal	<27><91><64>
IPCL	none
Description	The command allows an application to replace or redefine the active character set mapping in the printer. Where <L_L> <L_H> defines the total length of the following data: <L_L> + 256*<L_H> = 1 + 2 * is the total number of characters to be replaced. <B_C> is the first character in the active map to be replaced. <T_{1H}><T_{1L}>[8] is the internal address of the replacement character image. The mapping of a print pattern to each character address is referred to as a code page or character set. At any given time, the printer character set is comprised of 256 characters. Each character is addressed by an 8-bit value generally referred to as a character code. For example if you want to print an “A”, the character would be addressed by sending a <65> decimal to the printer. There are 65 predefined code pages or character maps that assign characters to a particular address built into the printer. However, there are times when an application would like to redefine a character or group of characters in a code page. To be able to redefine characters, the M90PLUS printer allows the map for any code page to be replaced. The “Define Character Set” command allows any character or group of characters to be replaced with any other printable character. There are over 500 printable master characters defined in the printer. For example, to redefine the character map for the 35th character and replace it with internal master character 346, the “Redefine Character Set”command is used as follows: [ESC] [S <3> <0> <35> <90> <1> ^^^^ ^^ ^^^^^^ | | +- 346th Character in the Master set | | [(1*256) + 90] | +------- 35th Character +----------- 3 Bytes to follow [(0*256) + 3] The new map will remain until the printer is power-cycled, or the character set is redefined. The code page and character set commands completely redefine the table.
Note	The OCR character set disable command ([ESC]y<12>) will also restore the character set to the original definition.

[8] The internal character map is provided in a separate document: 100-9785 Master Character Set Definitions.

Function	**OCR character enable**
ASCII	[ESC] y <11>
Hexadecimal	1BH 79H 0BH
Decimal	<27><121><11>
IPCL	&%YX011
EPOS	[ESC]y<11>
Description	The command replaces 30 characters in the currently selected character set with OCR-MA2 characters. OCR characters are only available in utility mode; utility mode is automatically selected when OCR is enabled.
Note	Do not switch out of utility mode until after the OCR characters are disabled. The other fonts do not contain these characters and will not print correctly.

Character	Name	Location Hex, Dec	ASCII Equivalent
0	Number 0	30H,48	0
1	Number 1	31H,49	1
2	Number 2	32H,50	2
3	Number 3	33H,51	3
4	Number 4	34H,52	4
5	Number 5	35H,53	5
6	Number 6	36H,54	6
7	Number 7	37H,55	7
8	Number 8	38H,56	8
9	Number 9	39H,57	9
A	Letter A	41H,65	A
X	Letter C	43H,67	C
Δ	Letter D	44H,68	D
M	Letter M	4DH,77	M
N	Letter N	4EH,78	N

Character	Name	Location Hex, Dec	ASCII Equivalent
Π	Letter P	50H,80	P
P	Letter R	52H,82	R
Y	Letter U	55H,85	U
Ξ	Letter X	58H,88	X
Ψ	Letter Y	59H,89	Y
ϒ	Symbol Hook	7EH,126	~
⇒	Symbol Chair	60H,96	`
◊	Symbol Fork	5FH,95	_
+	Plus Sign	2BH,43	+
−	Minus Sign	2DH,45	-
.	Period	2EH,46	.
/	Slant	2FH,47	/
∃	Dollar Sign	24H,36	$
>	Greater Than Sign	3EH,62	>
∀	Quotation Mark	22H,34	“

Table 8 OCR MA-2

The characters printed by the M90PLUS printer follow the format defined in the ANSI X3.111-1986 Standard. They should be printed in 10 or 12 cpi. By enabling enhanced print, the characters will have improved definition but will be printed at a slower speed.

Function	**OCR character disable**
ASCII	[ESC] y <12>
Hexadecimal	1BH 79H 0CH
Decimal	<27><121><12>
IPCL	&%YX012
EPOS	[ESC]y<12>
Description	The command returns the 30 OCR characters to the previously selected character set. It does not restore the print mode.
Note	Any character definitions deescribed by the redefine character set command are also replaced by the command.

5.5 Character Print Control

There are a number of character pitch and print mode operations that are possible and a few that are not. The following table lists the operations that are possible in matrix form.

Operation	8 cpi	10 cpi	12 cpi	15 cpi	17 cpi	20 cpi	24 cpi	Line Grph	Ital	Super /Sub	Util	NLQ	HSD	Emph	Enhan	Dbl-wide	Dbl-high	Under /Over
8 cpi								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
10 cpi								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
12 cpi								✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
15 cpi								✓	✓	✓	✓	☹	✓	☹	☹	✓	✓	✓
17 cpi								✓	✓	✓	✓	☹	✓	☹	☹	✓	✓	✓
20 cpi								✓	✓	✓	✓	☹	✓	☹	☹	✓	✓	✓
24 cpi								✓	✓	✓	✓	☹	✓	☹	☹	✓	✓	✓
Line graphics	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	☹	☹	✓	✓	☹
Italics	✓	✓	✓	✓	✓	✓	✓				✓	✓	☹	✓	✓	✓	✓	✓
Superscript/subscript	✓	✓	✓	✓	✓	✓	✓				✓	✓	☹	✓	✓	✓	✓	✓
Utility	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓
NLQ	✓	✓	✓	☹	☹	☹	☹	✓	✓	✓						✓	✓	✓
HSD	✓	✓	✓	✓	✓	✓	✓	✓	☹	☹				☹	☹	✓	✓	☹
Emphasize	✓	✓	✓	☹	☹	☹	☹	☹	✓	✓	✓		☹			☹	☹	✓
Enhanced	✓	✓	✓	☹	☹	☹	☹	☹	✓	✓	✓		☹			☹	☹	✓
Double-wide	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	☹	☹			✓
Double-high	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	☹	☹			✓
Under-/overline	✓	✓	✓	✓	✓	✓	✓	☹	✓	✓	✓	✓	☹	✓	✓	✓	✓	
Rotate 90˚/270˚	☹	✓	✓	☹	☹	☹	☹	✓	☹	☹	☹	☹	☹	☹	☹	☹	☹	☹

Table 9 Print modes

Notes: ✓ *Feature available*
☹ *Feature not available*

Some features switch to an alternate mode while active. For example, if line graphics are to be printed, the printer always prints them in a two-pass utility font at the selected pitch. Some enhanced or emphasized print formats are not available in 15 to 24 cpi.

Rotated 180˚ print fully supports all print features. Rotated 90˚ and 270˚ print in 5 x 7 font at 72 dpi is equivalent to a 12 cpi HSD font. Rotated print supports 10 cpi and 12 cpi by controlling the line spacing.

5.6 Character Pitch

Function	**Begin 10 cpi character pitch**
ASCII	[DC2]
Hexadecimal	12H
Decimal	<18>
IPCL	&%F3
EPOS	[ESC][SP] <n>
Description	The command sets ten characters per inch print pitch.

Function	**Begin 12 cpi character pitch**
ASCII	[ESC] :
Hexadecimal	1BH 3AH
Decimal	<27><58>
IPCL	&%F2
EPOS	[ESC][SP] <n>
Description	The command sets 12 characters per inch print pitch.

Function	**Begin 17 cpi character pitch**
ASCII	[SI]
Hexadecimal	0FH
Decimal	<15>
IPCL	&%F1
EPOS	[ESC][SP] <n>
Description	The command sets 17 characters per inch print pitch.

Function	**Begin 24 cpi character pitch**
ASCII	[ESC] [SI]
Hexadecimal	1BH 0FH
Decimal	<27><15>
IPCL	&%F4
EPOS	[ESC][SP] <n>
Description	The command sets 24 character per inch print pitch.

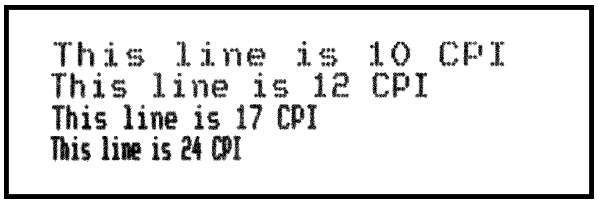


Figure 13 Resulting print

Function **Set specified character pitch**
ASCII [ESC] [P <n>
Hexadecimal 1BH 5BH 50H <n>
Decimal <27> <91> <80> <n>
IPCL &%F<n>
EPOS [ESC][SP] <n>
Description The command sets character per inch print pitch to <n>.

Where <n>:			
	8	selects 8 cpi	&%F7
	10	selects 10 cpi	&%F3
	12	selects 12 cpi	&%F2
	15	selects 15 cpi	&%F6
	17	selects 17 cpi	&%F1
	20	selects 20 cpi	&%F5
	24	selects 24 cpi	&%F4

Function **Set intercharacter spacing**
Mode Global
ASCII [ESC] V <n>
Hexadecimal 1BH 56H <n>
Decimal <27> <86> <n>
IPCL none
EPOS [ESC][SP] <n>
Description The command sets intercharacter spacing by adding white space between characters. The value of <n> sets the spacing and ranges from 0 to 11. The normal pitch set commands set the intervalue to 0. The amount of space depends on the pitch that was set. The following table specifies the amount of white space for each pitch setting.

Pitch	Spacing	Pitch	Spacing
HSD 8 cpi	1/80 * n	Utility/NLQ 8 cpi	1/150 * n
HSD 10 cpi	1/100 * n	Utility/NLQ 10 cpi	1/120 * n
HSD 12 cpi	1/120 * n	Utility/NLQ 12 cpi	1/144 * n
HSD 15 cpi	1/150 * n	Utility/NLQ 15 cpi	1/180 * n
HSD 17 cpi	1/171 * n	Utility/NLQ 17 cpi	1/205 * n
HSD 20 cpi	1/200 * n	Utility/NLQ 20 cpi	1/240 * n
HSD 24 cpi	1/240 * n	Utility/NLQ 24 cpi	1/288 * n

Table 10 Intercharacter spacing table

5.7 Character Attribute Commands

Function	**Begin one-line double-wide print**
ASCII	[SO]
Hexadecimal	0EH
Decimal	<14>
IPCL	&%MW
EPOS	none
Description	The command causes subsequent characters to be printed at twice the currently selected character width. For example, 10 cpi becomes 5 cpi, 17 cpi becomes 8.5 cpi, and so on. The command will remain in effect until: a. a valid line terminator is received (CR, LF, or fine linefeed); b. the command is canceled; or c. the maximum number of characters per line is reached, and the printer performs an automatic print.

```
Example of one-line double-wide[CR][LF]
This is normal 12 cpi Print[CR][LF]
[SO]
Double Wide[CR][LF]
This is back to normal[CR][LF]
```

Figure 14 Data sent to printer

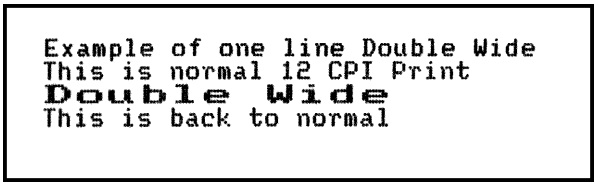


Figure 15 Resulting print

Function	**Cancel one-line double-wide print**
ASCII	[DC4]
Hexadecimal	14H
Decimal	<20>
IPCL	&%MN
EPOS	none
Description	The command cancels one-line double-wide mode set by the [SO] command and allows single- and double-wide characters to be printed on the same line.

Function **Multiline, double-wide, and double-high print**

ASCII [ESC] W <n>

Hexadecimal 1BH 57H <n>

Decimal <27><87><n>

IPCL &%FD, &%FS, &%FH

IPCL Note Single-wide, double-high mode is not available in IPCL.

EPOS [ESC] ! <n>

Description The command controls multiline, double-wide, and double-high mode.

Where n specifies the mode:

0	Standard single-wide and single-high	&%FS
1	Begin double-wide	&%FD
2	Begin double-high	none
3	Begin double-wide, double-high	&%FH

Note: The command does not affect line spacing.

EPOS Note [ESC]!<n> performs a similar function; however, NLQ mode is not available.

Where n-bits:

76543210	function
1-------	underline
--1-----	double-wide
---1----	double-high
-------X	font: 1 = Utility mode; 0 = HSD mode

Function **Set print style: double-wide, double-high, and italic control**

ASCII [ESC] [@ [EOT] [NUL] <k> [NUL] <n> <m>

Hexadecimal 1BH 5BH 40H 04H 00H <k> 00H <n> <m>

Decimal <27><91><64> <04> <0> <K> <0> <n> <m>

IPCL &%DH Double-high, double-wide, and double-space

&%SH Single-high, single-wide, and single-space

See also [ESC] W above.

Description The command sets double-wide, double-high, and italic print mode.

Where k-bits

76543210	
----xxxx	italic control
----0000	no change
----0001	italic on
----0010	italic off

Where n-bits

76543210	
----xxxx	height multiplier
----0000	no change
----0001	single-high
----0010	double-high
xxxx----	line spacing
0000----	no change
0001----	single linefeed
0010----	double linefeed

Where m-bits

76543210	
----xxxx	width multiplier
----0000	no change
----0001	single-wide
----0010	double-wide

Function	**Begin underline**
ASCII	[ESC] - <1>
Hexadecimal	1BH 2DH 01H
Decimal	<27><45><1>
IPCL	&%MU
EPOS	[ESC]!<n>
Description	The command begins underline print mode. All subsequent text and leading spaces will be underlined. Trailing spaces are also underlined.
Note	Underline is not available in HSD mode. See page 33 for available modes.
EPOS Note	[ESC]!<n> performs a similar function; however, NLQ mode is not available.

Where n-bits:

76543210	function
1-------	underline
--1-----	double-wide
---1----	double-high
-------X	font: 1 = Utility mode; 0 = HSD mode

Function	**End underline**
ASCII	[ESC] - <0>
Hexadecimal	1BH 2DH 00H
Decimal	<27><45><0>
IPCL	&%CU
EPOS	none
Description	The command ends underline print mode.

Function	**Begin overscore**
ASCII	[ESC] _ <1>
Hexadecimal	1BH 5FH 01H
Decimal	<27><95><1>
IPCL	&%MO
EPOS	none
Description	The command begins overscore print mode. All subsequent text and leading spaces will be overscored. Trailing spaces are also overscored.
Note	Overscore is not available in HSD mode. See page 33 for available modes.

Function	**End overscore**
ASCII	[ESC] _ <0>
Hexadecimal	1BH 5FH 00H
Decimal	<27><95><0>
IPCL	&%CO
EPOS	none
Description	The command ends overscore print mode.

Function	**Begin enhanced print**
ASCII	[ESC] G
Hexadecimal	1BH 47H
Decimal	<27><71>
IPCL	&%ME
EPOS	[ESC] G <1>
Description	All subsequent text will be printed in enhanced print mode (two pass with a vertical offset). Enhanced printing provides a deeper resolution of each character and may enhance multiple-part form printing.

Function	**End enhanced print mode**
ASCII	[ESC] H
Hexadecimal	1BH 48H
Decimal	<27><72>
IPCL	&%CE
EPOS	[ESC] G <0>
Description	The command cancels enhanced print mode and returns to the currently selected font.

Function	**Begin emphasized print**
ASCII	[ESC] E
Hexadecimal	1BH 45H
Decimal	<27><69>
IPCL	&%MM
EPOS	[ESC] E <1>
Description	The command begins emphasized print mode (one pass with horizontal offset). The print is bolder than normal print.

Function	**End emphasized print**
ASCII	[ESC] F
Hexadecimal	1BH 46H
Decimal	<27><70>
IPCL	&%CM
EPOS	[ESC] E <0>
Description	The command cancels emphasized print mode.

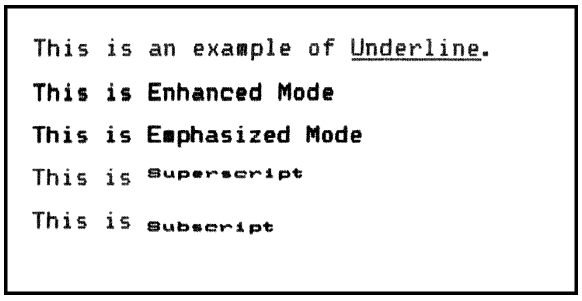
Function	**Select superscript**
ASCII	[ESC] S <0>
Hexadecimal	1BH 53H 00H
Decimal	<27><83><0>
IPCL	&%SP
EPOS	none
Description	The command selects superscript. All following characters will be printed half size on the upper half of the print line.
Note	The superscript feature is not available in all print modes. See page 33 for available modes.

Function	**Select subscript**
ASCII	[ESC] S <1>
Hexadecimal	1BH 53H 01H
Decimal	<27><83><1>
IPCL	&%SB
EPOS	none
Description	The command selects subscript. All following characters will be printed half size on the bottom half of the print line.
Note	The subscript feature is not available in all print modes. See page 33 for available modes.

Function	**End superscript or subscript**
ASCII	[ESC] T
Hexadecimal	1BH 53H
Decimal	<27><84>
IPCL	&%SE
EPOS	none
Description	The command ends superscript or subscript.

Function	**Begin italics**
ASCII	[ESC] % G
Hexadecimal	1BH 25H 47H
Decimal	<27><37><71>
IPCL	&%MI
EPOS	[ESC] 4
Description	The command begins italic print mode.
Note	Italics are not available in all print modes. See page 33 for available modes.

Function	**End italics**
ASCII	[ESC] % H
Hexadecimal	1BH 25H 48H
Decimal	<27><37><48>
IPCL	&%CI
EPOS	[ESC] 5
Description	The command ends italic print mode.



Resulting print

5.8 Print Rotation Commands

To provide printing flexibility on preprinted and various size forms, rotated print capability is provided in slip and receipt mode. Rotated print mode will adjust the print in any of three 90° orientations. In 90° and 270° rotated mode, the print data is first buffered by the printer, processed (rotated), and then printed which causes the print process to be delayed slightly as it takes some time to process the data before it is printed. In 180° mode, the print is simply inverted and mirrored.

Because the rotated 90° and 270° print buffer is limited to 2240 characters, the amount of rotated print is limited. The printer can support a limit of 28 lines of rotated print. Therefore, the maximum line length is 80 characters. The technique used by the Series 90PLUS printer is to receive all the print to be rotated and convert it into graphics. This requires buffer space for all possible characters in each print line. Each line has a fixed length buffer regardless of how much data is actually sent to the printer. The printer will fill the buffer for each line to the maximum size. As a result, a short line of two characters will take as much buffer space as a long line.

To make the most efficient use of buffer space, the line length is predefined. The default line length is 80 characters, which leaves room for 28 lines. To allow longer lines to be printed, the line length can be changed; however, no more than 28 lines and 128 characters per line are allowed. For example, if the line length is expanded to 128, there is buffer space for 2240/128 or 17 lines.

Specifying the line length is also useful to determine where data is printed on forms. In rotated 90° and 270° mode, the print field can be extended to print the complete line length specified. Extending the line length is useful for printing forms such as checks where the form is fixed but the data can change. This mode is called line formatted mode. In line formatted mode, the line length is set not by the longest line entered but by the maximum line length. (Line lengths less than 80 will not print more than 28 lines, only the format will be affected).

A line-spacing table controls the spacing between lines. The table is defined by the rotated-print line spacing ([ESC] u ...) command or by inserting [LF] or [ESC]J<n> commands in the rotated data. The [ESC]u command specifies the number of dots to be added between each printed line. Each line has an entry in the table. There is room for 28 lines in the table. The minimum spacing (and default) is one dot or 1/80 of an inch between lines which results in a total of ten dots in a line or 10/80 of an inch (8 lines per inch).

There are two rotated fonts in the printer, 5 x 7 and 7 x 9. If the character cell is 7 x 9 with one dot of white space[9] or the total cell size is 7 x 10, the cell is printed at 80 dots per inch. If three dots are added, there will be four dots total, and the cell will be 7 x 13. The following table specifies lines per inch for various numbers of inserted dots.

Number of dots added	0	1	2	3	4	5	6	7
Spacing specified	1	2	3	4	5	6	7	8
Cell size	7 x 10	7 x 11	7 x 12	7 x 13	7 x 14	7 x 15	7 x 16	7 x 17
Line spacing (inches)	0.125	0.1375	0.15	0.1625	0.175	0.1875	0.2	0.2125
Number lines per inch	8	7.27	6.67	6.15	5.71	5.33	5	4.7

Table 11 Rotated print spacing with 7 x 9 font

[9] Line graphic characters are 7 x 10 which allow touching characters as a default.

If the character cell is 5 x 7 with one dot of white space[10] or the total cell size is 5 x 8, the cell is also printed at 80 dots per inch. If three dots are to be added, there will be four dots total, and the cell will be 5 x 11. The following table specifies lines per inch for various numbers of inserted dots.

Number of dots added	0	1	2	3	4	5	6	7
Spacing specified	1	2	3	4	5	6	7	8
Cell size	5 x 8	5 x 9	5 x 10	5 x 11	5 x 12	5 x 13	5 x 14	5 x 15
Line spacing (inches)	0.10	0.1125	0.125	0.1375	0.15	0.1625	0.175	0.1875
Number lines per inch	10	8.89	8	7.27	6.67	6.15	5.71	5.33

Table 12 Rotated print spacing with 5 x 7 font

If a [LF] is used to specify the line spacing, it overrides the default table and sets spacing to 1 dot for 8 lines per inch. If [ESC]J<n> is used, <n> specifies the spacing in n/216 (including the one dot white space). Note: n/216 will be rounded to the nearest n/80, and the finest resolution allowed will be 1/80 inch.

In rotated 90° or 270° mode, the print is done in APA[11] graphics. The intercharacter spacing is adjusted with the normal line spacing commands. The [ESC]3<n> command is the most effective command for adjusting intercharacter spacing. Line spacing much less than 12 cpi will force the characters to overlap. (Spacing of 12 cpi is obtained with an [ESC] 3 <18>).

When 90° or 270° rotation is selected, only normal text can be printed. Underline, enhanced, emphasized, and other attributes will not function. See the chart on page 33 for a list of available features.

In 180° rotation mode, all spacing commands are effective. The mode of operation simply inverts and mirrors the print operation. All line spacing and print features are available. It should be noted that the feed direction is not effected by any of the rotate commands.

[10] Line graphics characters are 5 x 8 or 7 x 10 which allow touching characters as a default.

[11] APA - All Points Addressable

Function **Begin rotated print**

ASCII [ESC] r <X>

Hexadecimal 1BH 72H 0XH

Decimal <27><114><X>

IPCL &%RX

EPOS [ESC] T <3>

Description The command starts rotated print mode where X defines the mode as follows:

Where X = n-bits:	76543210	function
	----xx00	end rotated print
	----xx01	rotate 90°
	----0010	rotate 180°
	----xx11	rotate 270°
	----x1xx	use line formatting
	----0xxx	use 7 x 9 font
	----1xxx	use 5 x 7 font

If X = 1 or 9, rotate the print mode by 90°.

Print data is normally entered from left to right, top to bottom. When an end rotated print ([ESC] r <0>) command is received, the printer formats and prints the data.

If X = 5 or 13, rotate the print mode with formatting by 90°.

The command differs from the [ESC] r <1> command in that the line length is determined not by the longest line entered, but by the line length set by the [ESC] s command. If input extends past the end of a line, it will line wrap.

If X = 3 or 11, rotate the print mode by 270°.

The print will be rotated 270° according to the current stored format parameters.

If X = 5 or 13, rotate the print mode by 270°.

The print will be rotated 270° according to the currently stored format parameters. The command differs from the [ESC] r <3> command by spacing out the lines to the line length specified by the [ESC] s command. If input extends past the end of a line, it will line wrap.

If X = 2, rotate the print mode by 180°.

All subsequent lines will be rotated 180° and positioned at the opposite margin. All normal fonts and modes are available in 180° rotation mode. The format and font bits are ignored by the command. The command will remain in effect until rotation is canceled with an end rotated print ([ESC] r <0>) command, or a station-select command is issued.

Note The last line of print must be terminated with a line terminator before the end rotated command is issued. Any characters in the print buffer that have not been printed will not be printed. They will be printed unrotated when a line terminator is received.

EPOS Note The M90PLUS printer does not fully implement EPOS page mode. The [ESC] T <n> command functions identically to the normal mode [ESC] r <n> except the definition of <n> is different.

Rotated Print Summary

Function	**Begin 90˚ rotated print with 7 x 9 font**
ASCII	[ESC] r <1>
Hexadecimal	1BH 72H 01H
Decimal	<27><114><1>
IPCL	&%R1

Function	**Begin 90˚ rotated print with line formatting and 7 x 9 font**
ASCII	[ESC] r <5>
Hexadecimal	1BH 72H 05H
Decimal	<27><114><5>
IPCL	&%R5

Function	**Begin 270˚ rotated print with 7 x 9 font**
ASCII	[ESC] r <3>
Hexadecimal	1BH 72H 03H
Decimal	<27><114><3>
IPCL	&%R3

Function	**Begin 270˚ rotated print with line formatting and 7 x 9 font**
ASCII	[ESC] r <7>
Hexadecimal	1BH 72H 07H
Decimal	<27><114><7>
IPCL	&%R7
EPOS	[ESC] T <1>

Function	**Begin 90˚ rotated print with 5 x 7 font**
ASCII	[ESC] r <9>
Hexadecimal	1BH 72H 09H
Decimal	<27><114><9>
IPCL	&%R9

Function	**Begin 90˚ rotated print with line formatting and 5 x 7 font**
ASCII	[ESC] r <13>
Hexadecimal	1BH 72H 0DH
Decimal	<27><114><13>
IPCL	&%R4

Function	**Begin 270˚ rotated print with 5 x 7 font**
ASCII	[ESC] r <11>
Hexadecimal	1BH 72H 0BH
Decimal	<27><114><11>
IPCL	&%R8

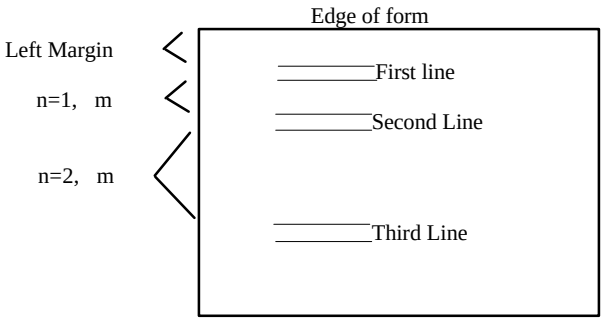
Function	**Begin 270˚ rotated print with line formatting and 5 x 7 font**
ASCII	[ESC] r <15>
Hexadecimal	1BH 72H 0FH
Decimal	<27><114><15>
IPCL	&%R6
EPOS	[ESC] T <1>

Function	**Begin 180° rotated print**
ASCII	[ESC] r <2>
Hexadecimal	1BH 72H 02H
Decimal	<27><114><2>
IPCL	&%R2

Function	**End rotated print**
ASCII	[ESC] r <0>
Hexadecimal	1BH 72H 00H
Decimal	<27><114><0>
IPCL	&%R0
EPOS	[ESC] { <0>
Description	In 90° or 270° mode, the command prints the contents of the rotated print buffer and returns to normal print orientation. In 180° mode, the printer returns to normal mode, and the characters in the print buffer that have not been printed will not be printed.

Function	**Set rotated print line length**
ASCII	[ESC] s <n>
Hexadecimal	1BH 73H <n>
Decimal	<27><115><n>
IPCL	&%RL <m_1> <m_2><m_3>
EPOS	none
Description	The command sets the print line length in autoformat rotated print mode. The maximum number of characters is 128 per line. The power on default line length is 80 characters. The number of available print lines is found by dividing 1760 by the number of characters per line and rounding down to the nearest whole number. The minimum number is 80 characters. Any value less than 80 will not allow any additional print lines to be printed. Values greater than 80 will limit the number of lines to less than 22.

Function	**Set rotated print line spacing**
ASCII	[ESC] u <n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i > <0>
Hexadecimal	1BH 75H <n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i> 00H
Decimal	<27><117> <n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i> <0>
IPCL	none
EPOS	none
Description	The command adjusts the line spacing for each rotated print line, where n_i is the line number and m_i is the spacing in dot columns (1/80 inch) from the previous line.



For the first print line, the distance is calculated from the margin. An n_i value of 0 is used to terminate the command. Any unspecified spacing will be set to 1 which allows data to be accurately positioned on an inserted form. These values will be used as a template for all subsequently rotated print. On power up, all spacing is preset to 1/80 inch (n = 1, eight lines per inch) for all lines. The command is only effective in 90° and 270° rotation mode. The command remains in effect until a new table is received or until the printer is power-cycled. An [ESC] u <0> will have the effect of setting all lines to 1. The table can be overridden by [LF] or [ESC] J <n> commands in the rotated print data. The value of m can be from 1 to 127; n can be from 1 to 22.
Table 11 on page 41 specifies the line spacing for the command.

5.9 Graphic Mode

The Series 90PLUS printer conforms to the full definition of IBM APA graphic commands. The printer will only print graphics that are 2.8 inches wide (2.4 inches with the narrow print zone) which can make it difficult to use off-the-shelf graphic generation programs.

If the Series 90PLUS printer is used with programs that convert text to graphics, the printer will be slower than if the printer is sent ASCII text. The Series 90PLUS printer is supported by a Windows' print driver that will allow applications to select fonts that are supported by the printer.

The Series 90PLUS printer is not designed to print large quantities of graphical data. If the printer is asked to print an excessive amount of black, it will break down the job into multiple steps. This protects the printer but slows the performance. The printer should not be requested to print a white on black image.

5.9.1 Standard APA Graphics

Function	**Print single-density graphics (60 h x 72 v dpi)**
ASCII	[ESC] K <n>[1] <n>[2]
Hexadecimal	1BH 4BH <n>[1] <n>[2]
Decimal	<27><75><n>[1] <n>[2]
IPCL	none
Description	The command prints n1 + 256*n2 bytes of single-density graphics (60 dpi).

Function	**Print half-speed, double-density graphics (120 h x 72 v dpi)**
ASCII	[ESC] L <n>[1] <n>[2]
Hexadecimal	1BH 4CH <n>[1] <n>[2]
Decimal	<27><76><n>[1] <n>[2]
IPCL	none
Description	The command prints n1 + 256*n2 bytes of double-density graphics (120 dpi) at half speed, allowing full and half dots to be printed.

Function	**Print full-speed, double-density graphics (120 h x 72 v dpi)**
ASCII	[ESC] Y <n>[1] <n>[2]
Hexadecimal	1BH 59H <n>[1] <n>[2]
Decimal	<27><89><n>[1] <n>[2]
IPCL	none
Description	The command prints n1 + 256*n2 bytes of double-density graphics (120 dpi) at full speed with no consecutive dots. (Full-speed, double-density graphic mode is generally used to print 120 h x 144 v dpi resolutions in two passes).

Function	**Print quad-density graphics (240 h x 72 v dpi)**
ASCII	[ESC] Z <n>[1] <n>[2]
Hexadecimal	1BH 5AH <n>[1] <n>[2]
Decimal	<27><90><n>[1] <n>[2]
IPCL	none
Description	The command prints n1 + 256*n2 bytes of double-density graphics (120 dpi) at full speed with no consecutive dots. (Quad-density graphic mode is generally used to print 240 h x 144 v dpi resolutions in two passes).

5.9.2 Extended APA Graphics

Function **Print graphics in mode <n> (60 h/120 h/240 h x 72 v dpi)**
ASCII [ESC] * <m> <n>[1] <n>[2]
Hexadecimal 1BH 2AH <m><n>[1] <n>[2]
Decimal <27><42><m><n>[1] <n>[2]
IPCL none
Description The command selects one of the three graphic modes listed above as specified by <m>.

Where <m>:			
0	60 dpi	full speed	8-bit slices
1	120 dpi	half speed	8-bit slices
2	120 dpi	full speed	8-bit slices
3	240 dpi	full speed	8-bit slices
4	80 dpi	full speed	8-bit slices
5	72 dpi	full speed	8-bit slices
6	90 dpi	full speed	8-bit slices
7	144 dpi	full speed	8-bit slices
8, 9, 11, 12, 13, 14, 16		not supported	

Function **Reassign graphic mode**
ASCII [ESC] ? <m> <n>
Hexadecimal 1BH 3FH <m><n>
Decimal <27><63><m><n>
IPCL none
Description The command reassigns graphic mode, <m>, to resolution, <n>. Possible values for <m> are K, L, Y, or Z. Resolutions, <n>, are 0 to 7 as follows:

Where <m>:				
0	60 dpi	full speed	8-bit slices	default for K
1	120 dpi	half speed	8-bit slices	default for L
2	120 dpi	full speed	8-bit slices	default for Y
3	240 dpi	full speed	8-bit slices	default for Z
4	80 dpi	full speed	8-bit slices	
5	72 dpi	full speed	8-bit slices	
6	90 dpi	full speed	8-bit slices	
7	144 dpi	full speed	8-bit slices	

Function **Begin unidirectional print**
ASCII [ESC] U <1>
Hexadecimal 1BH 55H 01H
Decimal <27><85><1>
IPCL &%GU
EPOS [ESC] U <1>
Description The command prints all data in unidirectional print mode to improve line to line registration for graphical data.
Note The command should be canceled before normal text is printed. It will slow printing time if it is not canceled.

Function	**Begin bidirectional print**
ASCII	[ESC] U <0>
Hexadecimal	1BH 55H 00H
Decimal	<27><85><0>
IPCL	&%GB
EPOS	[ESC] U <0>
Description	The command prints all data in bidirectional, logic-seeking print mode.

5.9.3 EPOS Bit Image Graphics

Function	**Print single-density graphics**
ASCII	[ESC] * <m> $<n>^1$ $<n>^2$
Hexadecimal	1BH 4BH $<n>^1$ $<n>^2$
Decimal	<27><75> $<n>^1$ $<n>^2$
Description	The command prints n1 + 256*n2 bytes of graphic, where m specifies the density.

Where m:			
	0	single-density graphics	60 dpi
	1	double-density graphics	120 dpi
	2	double-density half-speed graphics	120 dpi
	3	high-density graphics	240 dpi
	4, 5	CRT II screen	72 dpi
	6	CRT I screen	90 dpi
	7	dual plotter	144 dpi

Function	**Begin unidirectional print**
ASCII	[ESC] U <1>
Hexadecimal	1BH 55H 01H
Decimal	<27><85><1>
Description	The command prints all data in unidirectional print mode to improve line to line registration of graphic data.
Note	The command should be canceled before normal text is printed. It will slow printing time if it is not canceled.

Function	**Begin bidirectional print**
ASCII	[ESC] U <0>
Hexadecimal	1BH 55H 00H
Decimal	<27><85><0>
Description	The command prints all data in bidirectional, logic-seeking print mode.

5.9.4 Graphic-save

The Series 90PLUS printer contains a graphic-save buffer. The buffer is 2014 bytes long and can be saved in the printer's nonvolatile memory. The nonvolatile memory is read at power up and is available with a single command. The purpose of the graphic-save feature is to allow a graphic logo to be stored in the printer.

The buffer is designed to save a graphic image. However, any print information can be saved and then printed. The print information in the buffer can be replaced at any time and then printed. It does not need to be saved in the nonvolatile memory. It is feasible to use the buffer to create a duplicate receipt.

An additional feature of graphic-save is the ability to define a start-up macro. When the feature is activated, the graphic-save buffer is processed by the printer as part of its initialization. This allows the initial default state of the printer to be changed. The initial state can be reestablished by running the graphic-save buffer. In graphic-save mode, the buffer does not contain any printable data.

5.9.4.1 Programming considerations

The graphic-save feature works by inserting the save buffer into the printer data stream when the print graphic-save command is encountered.

Some care should be taken when forming the buffer because any configuration commands (like font or pitch changes) will remain in effect after the buffer is complete.

If the buffer is saved to nonvolatile memory, the saving process takes about seven seconds. The printer must be idle for the save to happen. The nonvolatile memory has a limited number of write-cycle operations. As a result, the number of saves should be limited. The buffer should not be saved on a transaction by transaction basis. Once a day should be the maximum.

Station-select commands cannot be placed in the graphic-save buffer. The buffer does not allow errors. If a station-select command fails, it will not be correctly processed. For this reason, the graphic-save buffer will not allow station-select commands to be kept. If a station-select command is included in the data stream, the buffer definition will be terminated, and the buffer will be deleted.

Illegal commands will also terminate and delete the graphic-save buffer during the definition process.

The buffer is 2000-bytes long. All commands[12] and print data are placed in the buffer, and both must be included in the 2000-byte limit. The printer does not indicate when it is full. The application must make sure that the buffer is not full. The printer will simply stop saving information in the buffer after 2000 characters are received.

As the buffer is filled, the input data is printed normally. The effect of the graphic-save start command is to begin saving the input data. The graphic-save stop command, discontinues saving data and initializes internal pointers for the next print. The graphic-save stop-and-save command, halts the save, writes the buffer to the nonvolatile memory, and initializes the internal pointers for the next print. The graphic-save print command inserts the buffer into the print stream.

[12] IPCL commands are converted by the printer into an equivalent [ESC] code and then placed in the save buffer. The equivalent [ESC] code should be used to calculate the size of the save-buffer data.

There is a configuration option that locks the graphic-save buffer and prevents a new graphic-save operation from occurring until the lock is manually reset, which inhibits accidental deletion of the graphic information.

Function	**Graphic-save print**
ASCII	[ESC] g <0>
Hexadecimal	1BH 67H 00H
Decimal	<27><103><0>
IPCL	&%GP
EPOS	[ESC] g <0>
Description	The command prints the graphic-save buffer.

Function	**Start graphic-save record**
ASCII	[ESC] g <1>
Hexadecimal	1BH 67H 01H
Decimal	<27><103><1>
IPCL	&%GS
EPOS	ESC] g <1>
Description	The command clears the graphic-save buffer and starts recording data. The next 2000 bytes (including characters and commands) will be recorded.

Function	**Stop graphic-save record**
ASCII	[ESC] g <2>
Hexadecimal	1BH 67H 02H
Decimal	<27><103><2>
IPCL	&%GE
EPOS	[ESC] g <2>
Description	The command stops recording graphic-save information. The buffer is not saved into nonvolatile memory.

Function	**Stop graphic-save record and save**
ASCII	[ESC] g <3>
Hexadecimal	1BH 67H 03H
Decimal	<27><103><3>
IPCL	&%GW
EPOS	[ESC] g <3>
Description	The command stops recording graphic-save information. The buffer is saved into the nonvolatile memory.
Note	The printer will remain busy for about seven seconds after the command to erase and resave the graphic-save buffer into the nonvolatile memory.

Function	**Stop graphic-save record and save as a start-up macro**
ASCII	[ESC] g <7>
Hexadecimal	1BH 67H 07H
Decimal	<27><103><7>
IPCL	none
EPOS	[ESC] g <7>
Description	The command stops recording graphic-save information and flags it as a start-up macro. The buffer is saved into nonvolatile memory.
Note	The printer will remain busy for about seven seconds after the command to erase and resave the graphic-save buffer into the nonvolatile memory. All future power-cycles will automatically run the macro. Redefining the macro with [ESC] g <3> will remove the start-up flag.

5.10 Bar codes

The Series 90PLUS printer supports the ability to print bar codes. The printer will print one of five formats, Interleaved 2 of 5, Code 39, Code 128, UPC A, and EAN-13. The host does not need to form the graphic image for these bar codes. The host need only send the printer the information to be bar coded, and a graphic will be generated. Bar codes can be printed in a high-resolution, normal mode or a fast, high-speed mode. The normal mode is more readable than the high-speed mode. (See the [ESC][EM]B command on the next page for setting the bar code height and print speed).

Function	**Print bar code**
ASCII	[ESC] b <n>{information}[ETX]
Hexadecimal	1BH 62H <n>... 03H
Decimal	<27><98><n> ... <3>
IPCL	&%25 ... [CR] Interleaved 2 of 5 &%39 ... [CR] Code 39 &%12 ... [CR] Code 128 &%UP ... [CR] UPC A &%EA .. [CR] EAN-13 &%UE ... [CR] UPC E &%E8 ... [CR] EAN-8 &%93 ... [CR] Code 93
EPOS	[ESC] b <n> or [GS] k <n>
Description	The command prints the information as a bar code. The bar code will be centered within the print zone.

Where n:

0	Interleaved 2 of 5	Numeric (0 - 9) only; must be an even number of digits
1	Code 39	26 uppercase letters (A - Z) and 10 digits (0 - 9)
2	Code 128	Three sets of 106 different characters
3	UPC A	Numeric (0 - 9) only; 11 digits
4	EAN-13	Numeric (0 - 9) only; 12 digits
5	UPC E	Numeric (0 - 9) only; 11 digits
6	EAN-8	Numeric (0 - 9) only; 6 digits
7	Code 93	26 letters; 10 digits (0 - 9); and 7 special characters

Interleaved 2 of 5 is a high-density, self-checking, continuous numeric bar code. It is mainly used where fixed length numeric fields are required. The data field must be an even number of characters. If an odd data field is sent to the Series 90PLUS printer, it will be zero padded. Due to space limitations, only 20 characters can be printed. Note: Interleaved 2 of 5 does not read well in high-speed mode.

Code 39 is an alphanumeric bar code. It is a discrete, self-checking, variable length code. The printer prints the complete data field. Due to space limitations, only ten characters can be printed. If illegal characters are passed to the printer, they are converted to legal codes, for example, a → A.

Code 128 is also an alphanumeric bar code. It is a high density, variable length, continuous code that employs multiple element widths. Code 128 has three possible start codes. The start code defines the set as Code A, B, or C. The first character in the data field defines the code set, start Code A = <135>, Code B = <136>, and Code C = <137>. The printer prints the complete data field. Due to space limitations, only ten characters can be printed. A check digit is generated by the printer.

Code 128 Note With Code 128, the "A" space is defined as <0>. This makes programming difficult and causes control character conflicts for the printer. To help solve these problems in Code 128, the Series 90PLUS printer subtracts 32 from all characters that are to be included in the bar code. In the Code 128 definition, an "A" is <33>, however, the printer will convert an ASCII "A" (<65>) to a <33> internally. This forces Code 128C and the start codes off by 32.

UPC A is a fixed length, numeric, continuous code that employs four element widths. The printer supports Universal Product Code Versions A and E and EAN-8 and EAN-13. Version A encodes 11 digits. Typically, the UPC A format starts with a number system digit, five-digit manufacturer's code, five-digit product code, and a check digit. The printer makes no assumptions about any of the codes except the check digit. The printer will print a UPC bar code with the 11 digits sent to it and generate the check digit. If fewer than 11 digits are sent, the remaining digits will be zero. The printer will print a UPC that is about 130 percent the size of the UPC nominal standard which provides optimal readability.

UPC E is a zero suppression version of UPC. The printer requires that the first digit is zero for number system zero. If it is not zero, the bar code is not printed. The printer does the compression based on the compression rules for UPC E. The printer will print a UPC bar code based on the 11 digits sent to it and generate the check digit. If fewer than 11 digits are sent, the remaining digits will be zero. The printer will print a UPC that is about 130 percent the size of the UPC nominal standard. This provides optimal readability.

EAN-13 is a fixed length, numeric, continuous code that employs four element widths. The printer supports EAN-13, which is a superset of UPC that encodes 12 digits. Typically, the format starts with a number-set digit, which defines how the next six digits are encoded. The next five digits have fixed encoding. The last is a check digit. The printer will print an EAN-13 bar code with the 12 digits sent to it and generate the check digit. If fewer than 12 digits are sent, the remaining digits will be zero. The printer will print an EAN-13 bar code that is about 130 percent the size of the nominal standard. This provides optimal readability.

EAN-8 is a fixed length, numeric, continuous code that employs four element widths. The printer supports EAN-8, which is a superset of UPC that encodes seven digits. The printer will print an EAN-8 bar code with the seven digits sent to it and generate the check digit. If fewer than seven digits are sent, the remaining digits will be zero. The printer will print an EAN-8 bar code that is about 130 percent the size of the nominal standard. This provides optimal readability.

Code 93 is an alphanumeric, variable length bar code. The complete data field is printed by the printer. Due to space limitations, only 12 characters can be printed.

Code 93 Note A [CR] may also be used in place of the [ETX] to end the bar code data field. Only information that is usable in a particular bar code will be printed.

Function	**Bar code height**
ASCII	[ESC] [EM] B <n>
Hexadecimal	1BH 19H 42H <n>
Decimal	<27><25><66> <n>
IPCL	&%BH $<m_1>$ $<m_2>$
EPOS	[GS]h<n>
Description	The command sets the bar code height and speed, where <n> is the number of print passes and <m> is the speed. Each pass is about 0.11 inch high. If n = <0>, the printer returns to the default values of four passes for all except UPC which is seven. Any value from zero to nine may be specified.

Function **Set bar code justification and human readable number print modes**

ASCII [ESC] [EM] J<n>

Hexadecimal 1BH 19H 4AH <n>

Decimal <27><25><74> <n>

IPCL &%BJ<m_1> <m_2>

EPOS none

The power on default is center justified with numbers on UPC bar codes.
Note: The command only effects bar code printing.

Description The command selects the operation of the bar code justification and number printing.

Where n-bits:	n	IPCL	76543210	
			------xx	justification
	0	00	------00	left
	1	01	------01	center
	2	02	------10	right
			----xx--	human readable
	0	00	----00--	no numbers
	4	04	----01--	numbers on UPC bar codes
	8	08	----10--	numbers on non-UPC bar codes
	12	12	----11--	numbers on all bar codes

5.11 Station Control

The Series 90PLUS printer differs from a normal computer printer in that it is meant for retail point-of-sale applications. Point-of-sale applications require that the printer has control sequences that are not normally found in data processing and general purpose printers. The control sequences fall into two categories: station control and miscellaneous control.

Receipt-only printers do not have movable form-compensation mechanisms. Only receipt operations are allowed. A station-select command is not required for these printers.

Receipt/Validation printers have a movable compensation mechanism which allows a form to be inserted between the print head and print platen. To allow the printer to operate the mechanism correctly, station-select and control commands are provided.

5.11.1 Receipt Operation

Normal receipt operation prints on the receipt tape. The receipt station can be equipped with journal take-up and/or a receipt cutter. Generally, the receipt station is idle.

Function	**Select receipt**
ASCII	[ESC] f
Hexadecimal	1BH 66H
Decimal	<27><102>
IPCL	&%SR
EPOS	[ESC] c 0 <n>
Description	The command enters receipt mode, closes the form compensation, and enables the receipt drive and take-up. All subsequent data will be printed on the receipt.
Note	All station-select commands reset rotated print and print justification. Print is set to 0° rotation, with left justification. If rotated print or justification is to be set, it must be set after the station-select command.

Function	**Activate receipt cutter**
ASCII	[ESC] v
Hexadecimal	1BH 76H
Decimal	<27><118>
IPCL	&%FC Cut
EPOS	[ESC] m or [ESC] i
Description	The command cuts the receipt tape and is only active in receipt mode. It will cut the receipt tape above the current print line.
Note	The command is only effective on printers with a knife.

5.11.1.1 Receipt Paper-error Sensor

The paper-error sensor in the Series 90PLUS printer monitors the diameter of the paper roll to determine how much paper is left. The sensor will report paper low to the software when a 1.27 inch roll diameter is reached. The amount of paper left on the roll depends on the type of paper being used. The following table specifies the amount of paper on the roll when paper low is sensed.

Single-ply	16 feet ± 8 feet
Double-ply	8 feet ± 4 feet
Triple-ply	4 feet ± 2 feet

There are four ways that the sensor can operate. The first is hard-fault mode. In hard-fault mode when paper low is detected, the printer goes off-line and stops. (To select this option, choose Mode 1 with 0 feet). The second is soft-fault mode. With soft-fault mode when the printer detects paper-low, an error is visually displayed to the operator. The printer will continue to print for the number of lines specified by the paper-error command. (To select this option, choose Mode 2 with from 1 to 15 feet). When paper-low status is detected in the third method, the printer continues to print for a specified length of paper and faults with no operator warning. (To select this option, choose Mode 1 with from 1 to 15 feet). In the fourth method, the paper-low signal is completely ignored, and the printer will print with no paper[13] or error fault. (To select this option, choose Mode 0 with 0 feet).

When the printer generates a paper out fault, the printer stops printing. Because the paper out fault is calculated, the paper may not be completely out. By pushing the RESUME key, the printer will add four inches to the paper out length. This can be done as long as the cover is not opened. It is possible, however, to print past the end of the receipt roll by continually pushing the RESUME key.

[13]This mode should not be selected unless the receipt station is not to be used. In other words, it must be a validation only printer.

Note: in disabled mode, the [ENQ] command for receipt-paper status will not operate. It will always return "paper present".

Function **Select paper-error operation**

ASCII [ESC] p <n>

Hexadecimal 1BH 70H

Decimal <27><112>

IPCL &%PE <m_1> <m_2>

EPOS [ESC] c 3 <n>

Description The command selects the operation of the receipt paper-status sensor.

Where n-bits:	n	IPCL	76543210	
			----xxxx	paper length to fault
	0		----0000	immediate
	1		----0001	1 foot
	15		----1111	15 feet
			yyyy----	mode
	0	00-15	0000----	nofault generation (Paper-error is disabled. Paper-error off is for validation-only printers).
	16	16-31	0001----	immediate fault after n feet
	32	32-47	0010----	paper low warning, then fault with visual warning

Note The default mode is specified in the printer configuration.
Typical values for Mode 2 are 8 feet with 1-ply, 4 feet with 2-ply, and 2 feet with 3-ply.

Function **Disable the paper out sensor**

ASCII [ESC] 8

Hexadecimal 1BH 38H

Decimal <27><56>

IPCL &%PF

EPOS none

Description The command is intended to temporarily disable the paper out sensor. The printer will not stop printing or go off-line when it senses that it is out of paper. The [ENQ] command will still return paper out status.

Function **Enable the paper out sensor**

ASCII [ESC] 9

Hexadecimal 1BH 39H

Decimal <27><57>

IPCL &%PO

EPOS none

Description The command is intended to reverse the effect of the disable paper out sensor command. If the printer is out of paper when this command is issued, it will go off-line.

5.11.2 Validation and Slip Operation

There are two modes of form validation operations with the Series 90PLUS printer.

5.11.2.1 Top Insertion Validation

With top insertion, the form is inserted from the top and extends out the left side and/or top of the printer. It rests on the form's fixed stop. Under software control, printing can begin from a minimum of two lines to a maximum of 17 lines from the bottom of the form. A maximum of 17 lines at 42 characters can be printed on a form. In this manual, top insertion will be termed "validation mode."

Depending on application requirements, the host system or the printer can control the form insertion procedure. In most cases, the only difference will be whether the operator is prompted by the host system or by the printer.

5.11.2.1.1 Validation Controlled by the Host System

1. The host system indicates to the operator that a form is to be inserted for validation.
2. The form is inserted into the printer and sensed by the application.
3. The host system closes the validation clamp and prints on the form. When the printing is complete, the host releases the form.
4. The host application prompts the operator to remove the form.

5.11.2.1.2 Validation Controlled by the Printer

1. The host system sends a validation transaction to the printer. The transaction starts with an [ESC][DC4] or an [ESC]j<n> command.
2. The printer opens the validation clamp, so the form can be inserted. The FORM light blinks, and the READY light turns orange. The form is then inserted into the printer using one of the following procedures.
   a. In full insertion, right-justified validation ([ESC][DC4], [ESC]j<0>, or [ESC]j<3>), the form must be fully inserted down and to the right. The green form guide on the right side of the validation slot is used to justify the right side of the form. The form must then be pushed all the way down until the orange READY light turns green.
   b. In full insertion, not justified ([ESC]j<1>), the form must be fully inserted down but need not be justified to the right. The position of the form from right to left is up to the operator. The printer only looks at the bottom sensor to signal insertion. As soon as the form is pushed all the way to the bottom of the validation slot, the orange READY light turns green, and the form is clamped.
   c. In right justified insertion ([ESC]j<2>), the form must be all the way to the right but need not be all the way down in the validation slot. The vertical position of the form is up to the operator; the printer only looks at the right sensor to clamp the form. As soon as the form is justified to the right side of the validation slot, the orange READY light turns green, and the form is clamped.
3. The printer will print the buffer transaction.
4. When the print is complete, the last command in the transaction should be a form-eject ([ESC]k) or open-clamp ([ESC][DC1]) command. The printer releases the form, and the operator removes it. If a second transaction is sent to the printer before the form is removed, the printer will wait the eject-wait time for the form to be removed. If the form is not removed, the printer will enter dejam mode and signal the operator to remove the form. When the operator presses the RESUME key, the second transaction will start.

5.11.2.2 Front Inserted Forms

The form is inserted from the front and extends out the left side and/or front of the printer. It does not rest on a fixed stop. In front insertion mode, the form is loaded to the first line of print under firmware control. Printing begins from the top of the form. The first line printed is under software control from the application. In this manual, front insertion mode will be termed “slip mode.” All Series 90PLUS validation printers have both validation and slip modes.

5.11.2.2.1 Slip Printing

In slip mode, the form to be printed on is inserted into the front of the printer. The printer always controls slip mode.

1. The host system sends a slip transaction to the printer.
2. The printer opens the slip clamp, so a form can be inserted. The FORM light blinks and the READY light turns orange.
3. The form is inserted into the front of the printer using the right slip guide to right justify the form. The form is inserted until the orange light turns green.
4. When the orange light turns green, the form is properly positioned, and the printer clamps the form automatically. Note: If the operator inserts the form too far, the printer may back it up to correctly position it.
5. The printer automatically positions the form to the top line. When the form is positioned correctly, the printer is ready to print. If the form is not positioned correctly, the printer generates an error. The READY light flashes orange, and the FORM light flashes green. The printer will enter dejam mode which will release the form. The operator should then remove the form and press the RESUME button, which will restart the slip-load operation.
6. When the form is properly loaded, the printer will print the buffered transaction.
7. The last command in the slip transaction should be an eject-form ([ESC]k) command. This command will feed the form up and out of the printer until it clears the lower feed rollers. The printer will release the form, and the operator should remove it. If a second transaction is sent to the printer before the form is removed, the printer will wait the eject-wait time for the form to be removed. If the form is not removed, the printer will enter dejam mode and signal the operator to remove the form. When the operator presses the RESUME key, the second transaction will start.

5.11.2.3 Mode Selection

To make controlling the Series 90PLUS printer as easy as possible, the printer can be configured to automatically reselect the receipt station after validation or slip operations. Autoreceipt select operates differently depending on the mode of operation.

In validation mode with autoform sense, the printer can be configured to time out the operation and return to receipt mode. The time out is set by the validation-delay command. This time can be set from 1/2 second to two minutes, or it can be turned off (no time out). The default for this delay is off.

The open-for-validation command without autoform sense will automatically return to receipt mode if data is sent to the printer without a close-for-validation command. In this case, the form clamp will be held open for at least two seconds as a default. This time can be set from 1/2 second to two minutes, or it can be turned off (no time out).

In slip mode, the command can be configured to time out and return to receipt mode if no form is inserted. This time can be set from 1/2 second to two minutes, or it can be turned off (no time out). The default is off.

After the eject-form command, the printer will automatically reselect the receipt station if additional print data is sent to the printer. This mode uses the same time delay as the open-for-validation command without autoform sense. The delay specified must expire before the printer will close the clamp and return to receipt mode. In this case, the form clamp will be held open for at least two seconds as a default. This time can be set from 1/2 second to two minutes, or it can be turned off (no time out).

5.11.3 Top Validation Operation

Function	**Open for validation**
ASCII	[ESC] [DC1]
Hexadecimal	1BH 11H
Decimal	<27><17>
IPCL	&%VO
EPOS	[ESC] c 0 <n>
Description	The command opens the form compensation assembly for validation. No automatic-validation form sensing is performed. The application must poll the printer for validation forms present and then issue a close-compensation command.
Notes	The command can be set to time out. If data is sent to the printer after the command but before a close-for-validation command, the printer will return to receipt mode and print the data.

Function	**Close for receipt/validation**
ASCII	[ESC] [DC3]
Hexadecimal	1BH 13H
Decimal	<27><19>
IPCL	&%VC
EPOS	[ESC] c 0 <n>
Description	The command closes the form compensation assembly and enters validation mode if either the top form sensor or the slip-stop sensor recognize a form. If no form is sensed, the printer will close the form compensation assembly and enter receipt mode. If a form is sensed, the printer will be in validation mode until another mode is issued. After the validation operation is complete, an eject-form or open-for-validation command should be issued. The printer will not count validation lines or sense the end of the form. The application should take care to not print past the end of the form. There are two inches of validation space. The receipt-mode select command can be issued at the end of the validation operation. However, the clamp will not be opened, and if a form is sensed, the printer will enter dejam mode.
Note	All station-select commands reset rotated print and print justification. Print is set to 0° rotation, with left justification. If rotated print or justification is to be set, it must be set after the station-select command.

Function	**Select validation operation**
ASCII	[ESC] [DC4]
Hexadecimal	1BH 14H
Decimal	<27><20>
IPCL	&%VS
EPOS	[ESC] c 0 <n>
or ASCII	[ESC] j <n>
Hexadecimal	1BH 6AH <n>
Decimal	<27><106> <n>
IPCL for <n> = 1	&%VB
IPCL for <n> = 2	&%VR
IPCL for <n> = 3	&%VS
EPOS	[ESC] c 0 <n>
Description	These commands open the form compensation assembly for validation. When the form is sensed, the printer automatically clamps it. Data sent to the printer after the select validation mode command will be printed in validation mode. The eject-form command should be used to release the validation form at the end of the transaction. The [ESC][DC4] command requires that the form be inserted to the right and completely down in the printer to be clamped. The [ESC] j <n> command allows the positioning of the form to be selected.
<n> = 1	If <n> = 1, the form may be placed anywhere in the print area; it need not be all the way to the right. It must, however, be completely down in the printer.
<n> = 2	If <n> = 2, the form must be placed all the way to the right in the print area; it need not be all the way down. The form will be clamped after the right sensor detects it. The form must be manually positioned to the print line.
<n> = 0 or 3	If <n> = 0 or 3, the form must be placed all the way down and to the right in the print area. The form will be clamped after both sensors detect it. The command is the same as [ESC][DC4].
Notes	1. All station-select commands reset rotated print and print justification. Print is set to 0° rotation with left justification. If rotated print or justification is to be set, it must be set after the station-select command. 2. Any data sent to the printer after an eject command is printed on the receipt. 3. The command can be set to time out. 4. See validation control for additional control commands.

5.11.4 Front Slip Operation

Function	**Select front-slip mode**
ASCII	[ESC] i
Hexadecimal	1BH 69H
Decimal	<27><105>
IPCL	&%VF
EPOS	[ESC] c 0 <n>
Description	The command operates front-slip mode and takes several steps to complete. 1. The front-slip throat is opened, and the printer waits for a slip to be inserted. 2. When a slip is sensed, it is clamped. The slip is then fed up to the form position sensor. The sensor is located close to the top feed rollers and to the right side of the printer. The sensor location ensures that the top of the

form is accurately positioned and the form is not skewed. The operator should release the form as soon as it is clamped. (If the operator does not release the form, it is possible the form will be mispositioned when the slip drive transfers from the lower drive to the primary drive.)

3. If the form is not sensed by the form position sensor, an error is generated. The slip is unclamped, and the operator should remove it. The operator can restart the command with the RESUME key. If the form is in position, the top edge is calibrated and clamped by the primary slip/validation drive.
4. The form is then positioned to the first line of print.

Notes

1. All station-select commands reset rotated print and print justification. Print is set to 0° rotation with left justification. If rotated print or justification is to be set, it must be set after the station-select command.
2. The first line of print is adjustable by the adjust-slip-position command and in initial configuration.

Function	**Eject slip**
ASCII	[ESC] k
Hexadecimal	1BH 6BH
Decimal	<27><107>
IPCL	&%VE
EPOS	[ESC] c 0 <n>
Description	The command ejects the slip or validation form out of the printer and opens the form clamp.
Note	If the command is followed by another station-select command and the form has not been removed from the printer, the station-select command will wait for the eject-wait time. If the form is removed before the eject-wait period, the printer will enter the selected station mode. If the form is not removed in time, the printer will enter dejam mode. This delay is adjustable. See [ESC][EM]W on page 65.

Function	**Release slip**
ASCII	[ESC] z
Hexadecimal	1BH 7AH
Decimal	<27><122>
IPCL	&%FR
EPOS	none
Description	The command releases the slip by partially opening the form clamp.
Note	If this command is followed by another station-select command and the form has not been removed from the printer, the station-select command will wait for the eject-wait time. If the form is removed before the eject-wait period, the printer will enter the selected station mode. If the form is not removed in time, the printer will enter dejam mode. This delay is adjustable. See [ESC][EM]W on page 65.

5.11.5 Validation and Slip Operation Control

Automatic validation operations can be adjusted for specific applications. The following commands adjust print and form positions and delays used to sense forms.

The Series 90PLUS printer has several features that can be altered during operation. For example, the time delay between when a form is sensed and when the form clamp is activated can be changed. This allows the operation of the printer to be tailored to the application and the form.

All feature control commands are extensions of the [ESC][EM] sequence. They are defined as follows.

Function	**Validation clamp delay**
ASCII	[ESC] [EM] C <n>
Hexadecimal	1BH 19H 43H <n>
Decimal	<27><25><67> <n>
IPCL	&%ZC <m_1> <m_2>
EPOS	[ESC] f
Description	The command sets slip-clamp delay. Slip-clamp delay is the time between when the slip is sensed and the form is clamped. (Only the smallest 4-bits are used.) The default is configurable.
	Where <n>: 0 0 ms 1 50 ms 2 150 ms, and so on until 15 750 ms
Note	The command must be issued before the station-select command. The validation-clamp delay is active for front and top validation form insertion. Once issued, the value will be used until the printer is power-cycled or the command is reissued.

Function	**Set slip-validation time out**
ASCII	[ESC] [EM] S <n>
Hexadecimal	1BH 19H 53H <n>
Decimal	<27><25><83><n>
IPCL	&%ZS <m_1> <m_2>
EPOS	[ESC] f
Description	The command sets the time out after a front-validation command is issued and the printer returns to receipt mode. Where <n> is the delay in one minute increments. The minimum time out is 1 minute, and the maximum is 15 minutes. If <n> = 0, the delay is set to no time out (waits forever). The default is configurable.

Function	**Set validation time out**
ASCII	[ESC] [EM] V <n>
Hexadecimal	1BH 19H 56H<n>
Decimal	<27><25><86><n>
IPCL	&%ZV <m_1> <m_2>
EPOS	[ESC] f
Description	The command sets the time out after a top validation command with autosense is issued and the printer returns to receipt mode. Where <n> is the delay in one minute increments. The minimum time out is 1 minute, and the maximum is 15 minutes. If <n> = 0, the delay is set to no time out (waits forever). The default is configurable.

Function	**Set clamp-open time out**
ASCII	[ESC] [EM] U <n>
Hexadecimal	1BH 19H 55H<n>
Decimal	<27><25><85><n>
IPCL	&%ZU <m_1> <m_2>
EPOS	[ESC] f
Description	The command sets the minimum time the clamp will remain open after an eject-form command. This time out must expire before the clamp will automatically close and return to receipt mode. It will only be used if print data is received before another station-select command. Where <n> is the delay in two second increments. The minimum time out is 0 seconds, and the maximum is 30 seconds. If <n> = 0, the delay is set to no time out. The default is configurable.

Function	**Set eject-wait time**
ASCII	[ESC] [EM] W <n>
Hexadecimal	1BH 19H 57H<n>
Decimal	<27><25><87><n>
IPCL	&%ZW <m_1> <m_2>
EPOS	none
Description	When a station-select command is issued to the printer, the printer checks the paper path. If there is a form in the paper path, an error is issued, and the printer enters dejam mode. To allow the printer to receive back to back transactions, the printer waits before issuing an error for the form to be removed. This time is the eject-wait time. The time starts after an eject command and is used only if a station-select command is issued before the time out and if there is a form in the path. Where <n> is the delay in two second increments, the minimum eject-wait time is 0 seconds, and the maximum is 30 seconds. If <n> = 0, the delay is set to no time out. The default is configurable.

Function	**Set eject-pause time**
ASCII	[ESC] [EM] D <n>
Hexadecimal	1BH 19H 44H<n>
Decimal	<27><25><68><n>
IPCL	&%ZD <m_1> <m_2>
EPOS	none
Description	The command sets the delay between when the eject-wait process detects that the form has been removed and the next station-select command has started. The eject-pause gives the operator time to completely remove the form. (Only the smallest 4-bits are used). The default is configurable. Where <n>: 0 0 ms 1 5 ms 2 150 ms, and so on until 15 750 ms

Function **Top of slip position**
ASCII [ESC] [EM] P <n>
Hexadecimal 1BH 19H 50H <n>
Decimal <27><25><80> <n>
IPCL &%ZP <m_1> <m_2>
EPOS none
Description The command adjusts the position of the first line of print in slip mode. Where <n> is the offset from the top of the form in 1/72 inch, n may be from 0 or 0/72 to 15 or 15/72 inches. The slip position command allows fine adjustment of the top of inserted forms. The default is configurable.
Notes
1. The command must be issued before the station-select command. It is only active for front-form validation operations. Once issued, the value will be used until the printer is power-cycled or the command is reissued.
2. In normal mode, printing begins 0.06 inch from the top edge of the form. In EPOS mode, printing begins 0.2 inch from the top edge of the form.

Function **Set left/right print margin**
ASCII [ESC] X <n1> <n2>
Hexadecimal 1BH 58H <n1> <n2>
Decimal <27><88> <n1> <n2>
IPCL none
EPOS [ESC]l, [ESC]Q
Description The command sets the left and right print margins in characters from the home position.
Where: <n1> = left margin
<n2> = right margin
Note: the absolute position depends on the current print pitch.

	8 cpi	10 cpi	12 cpi	15 cpi	17.1 cpi	20 cpi	24 cpi
Max. columns	22	28	34	42	48	56	66
<n1>	1 to 20	1 to 26	1 to 30	1 to 39	1 to 43	1 to 52	1 to 63
<n2>	<n1>+2 to 22	<n1>+2 to 28	<n1>+3 to 34	<n1>+3 to 42	<n1>+4 to 48	<n1>+4 to 56	<n1>+4 to 66

If the left and right margins are set to the right of the current horizontal position, the new left and right margins become valid in the same line.
If the left margin is set to the left of the current horizontal position and the right margin to the right of the current horizontal position, the right margin becomes valid in the same line, but the left margin setting becomes valid in the next line.
When the left and right margins are set to the left of the current horizontal position, both left and right margin settings appear to become valid in the next line. This is because an auto-CR is performed by the following data.

Function	**Enable or disable dual-station operation**
ASCII	[ESC] l <n>
Hexadecimal	1BH 6CH <n>
Decimal	<27><108><n>
IPCL	&%SD (enable dual-station)
IPCL	&%SS (single-station)
EPOS	none
Description	The command enables or disables dual-station mode. If n = 1, dual-station mode is enabled. In dual-station mode, both the receipt and validation/slip paper feed drive will operate allowing the journal to record the information printed on the inserted form. If n = 0, the printer will revert back to single station operation. The effect of this command is to enable receipt feed in slip or validation modes.
Note	Any station-select command will disable dual-station mode.

5.12 MICR Reader

5.12.1 Overview

The MICR reader is an option for the M90PLUS printer. It is attached to the front of the printer and allows a document having MICR data on it to be read and positioned for print.

MICR is an acronym for Magnetic Ink Character Recognition. A MICR reader's function is to read the information printed on the bottom of a check and transmit that information to the host. The line of information at the bottom of a check is called MICR because it is printed in magnetic ink. The magnetic ink contains iron particles, which may be read using MICR technologies.

Check readers are able to recognize the characters using either Optical Character Recognition (OCR) or magnetic-reading technology. Some check readers intended for retail point-of-sale use OCR techniques to read the MICR information. Because an OCR check reader can be defrauded using a pen or pencil, the technique has been rejected by the market.

The MICR reader only recognizes magnetic ink. It is not an optical reader. The M90PLUS MICR reader is based on a technique which uses a magnetic read head to pick up a signal from a document containing magnetic ink. The M90PLUS MICR reader also recognizes E13-B characters. It does not read CMC-7 characters. (CMC-7 is used in Latin America and Europe).

For a complete description of the MICR reader's operation and programming, refer to the M90PLUS MICR Reader Programmer's Guide.

The following is a brief list of MICR commands. These commands are not valid unless a MICR reader is attached.

Function	**MICR reader reset**
ASCII	[ESC]mI
Hexadecimal	1BH 6DH 49H
Decimal	<27> <109> <73>
IPCL	&%MQ
Return	[ETB] <l> Status
Description	The command resets the MICR reader to the initial state. It returns status as a result. The status is always 0 unless the reader is defective.

Function	**MICR reader status request**
ASCII	[ESC]ms
Hexadecimal	1BH 6DH 53H
Decimal	<27> <109> <83>
IPCL	&%MS
Return	[ETB] <l> Status
Description	The command requests that the MICR reader returns its current status.

Function **MICR read request (No data is returned).**
ASCII [ESC]mP
Hexadecimal 1BH 6DH 50H
Decimal <27> <109> <80>
IPCL &%MP
Return none
Description The command asks the MICR reader to wait for and then read a document. It does not return the data or any resulting error status.
Inquire commands should be used to track the read process. The [ESC]mD (return data) command will then return the MICR data.

Function **MICR read request and data return**
ASCII [ESC]mR
Hexadecimal 1BH 6DH 52H
Decimal <27> <109> <82>
IPCL &%MR
Return [ETB] <l> Data or [CAN] <l> Status
Description The command asks the MICR reader to wait for and then read a document. It returns the data or a result error status.
[ETB],<length>, read states, data
or
[CAN], <length>, failure status
The status fields are defined as follows:

Failure Status Bytes	Description
0CFH, 00H	Document speed too slow
0CEH, 00H	Sensor error
0CDH, 00H	Paper jam
0CCH, 00H	No read has occurred

Read Status Bits	Description
Bit 0	Data present
Bit 1	Amount field present
Bit 2	Amount field present with errors
Bit 3	Transit field check-sum failed
Bit 4	Auxiliary OnUs field present
Bit 5	Unreadable data present (not including amount field)
Bit 6	Always 1
Bit 7	Always 0

Function	**MICR data request**
ASCII	[ESC]mD
Hexadecimal	1BH 6DH 44H
Decimal	<27> <109> <68>
IPCL	&%MD
Return	[ETB] <length> read status, data or [CAN] <length> fault status
Description	The command asks the MICR reader to return previously read data. The response is the same as the read command.

Function	**MICR load request**
ASCII	[ESC]mL
Hexadecimal	1BH 6DH 4CH
Decimal	<27> <109> <76>
IPCL	&%ML
Return	none
Description	The command asks the printer to load a previously read document into print position. No status is returned. If the load fails, the printer enters a load error mode. In this case, the document will be released and must be reloaded into the printer using the normal slip path.

Function	**MICR eject request**
ASCII	[ESC]mE
Hexadecimal	1BH 6DH 45H
Decimal	<27> <109> <69>
IPCL	&%MP
Return	none
Description	The command asks the printer to reject the document. The document is feed through the printer and ejected out of the top. The document is then released.

Function	**MICR transport request**
ASCII	[ESC]mT
Hexadecimal	1BH 6DH 54H
Decimal	<27> <109> <84>
IPCL	&%MT
Return	none
Description	The command asks the printer to load a document for printing. The document is feed through the reader but not read. The document is then positioned to the top of the form.

Function **Set MICR start delay set**
ASCII [ESC] [EM] M <n>
Hexadecimal 1BH 19H 4DH <n>
Decimal <27><25><77> <n>
IPCL &%ZM <m_1>
EPOS none
Description The command adjusts the delay from when the MICR document sensor sees the document until the transport is started. The command allows time for the operator to align the document before the reader clamps it. The default is 150 milliseconds.

Where <n>:
0 0 ms
1 100 ms
2 200 ms, and so on until
7 700 ms

Function **MICR read cancel**
ASCII [ENQ] <12>
Hexadecimal 05H 0CH
Decimal <5><12>
IPCL none
Description The [ENQ] command is a real-time command that forces a MICR read command to stop and return no data. The command can be used to get the printer out of a read command. It has no other effect on the printer and is always acknowledged. (See another ENQ command for a description). If the read is complete before the ENQ <12> is issued, the read command will operate normally.

Function **Set Translation Table**
ASCII [ESC] m X <n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i> <0>...
Hexadecimal 1BH 6DH 58H <n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i> <0>
Decimal <27><109> <88><n_1> <m_1> <n_2> <m_2> ... <n_i> <m_i> <0>
IPCL none
Description The command sets the MICR translation characters. If no translation is specified, the symbols shown in the table below are used. The command does not save the table to the configuration EEPROM.

Where: n = the ID
m = the character to translate to

Table ID <n>	Code <m>	Hex	Function
1	T	74H	Transit symbol
2	-	2DH	Dash symbol
3	A	61H	Amount symbol
4	O	6FH	OnUs symbol
5	<sp>	20H	Blanks between characters
6	?	3FH	Rejected character

5.13 Miscellaneous Controls

Function	**Clear print buffer**
ASCII	[CAN]
Hexadecimal	18H
Decimal	<24>
IPCL	&%RP
EPOS	[CAN]
Description	The command clears the print buffer and any unprinted information in the printer received before the [CAN]. If the input buffer is not being processed (because the printer is out of paper or the form is not inserted), the CAN command will not be processed until after the error is cleared. The CAN command does not restore default conditions. It only clears the print buffers.

Function	**Query marker**
ASCII	[ESC] q <n>
Hexadecimal	1BH 71H <n>
Decimal	<27><113>
IPCL	none
EPOS	none

Function	**Return a status to the host during processing**	
Response	**Serial/ Parallel, IEEE 1284**	**Parallel, non-IEEE 1284**
	[SOH]<n>…	not supported via PE
Description	The command can be placed in the print data and, when processed by the printer, will return a progress status marker. The value of <n> can be any 8-bit value. It is returned to the host unaltered. The intent is for it to be a sequence number. The command can be used to track the print progress of the printer or verify that the data has been printed.	
Note	The command is a line terminator and causes the printer to print all previous data. If a normal line terminator (like a [CR]) is not supplied, right justify and autocenter will not function correctly. All data will be left justified. [ESC]q does not perform a [CR] or [LF] function.	

Function **Open cash drawer**
ASCII [ESC] x <n>
Hexadecimal 1BH 78H <n>
Decimal <27><120><n>
IPCL &%D1 for Cash Drawer 1
IPCL &%D2 for Cash Drawer 2
EPOS [ESC] p
Description The command energizes the Cash Drawer n for 150 milliseconds.
Where <n>: <1> (01H) or 1 (31H) for Cash Drawer 1
<2> (02H) or 2 (32H) for Cash Drawer 2
The time period the drawer is activated can be changed in the configuration menu. The activation time can be set from 25 to 250 milliseconds.
Notes
1. The open cash drawer commands are processed as part of print data. They are not processed until they are found in the input buffer by the print processor. They are not immediate commands.
2. Cash Drawer 2 is factory configurable in one of two modes. Either Pin 2 or 3 is active depending on an internal jumper setting. The factory default is Pin 3. Cash Drawer 1 is always on Pin 2.
3. The cash drawer status is defined as an open circuit for drawer closed.

Function **Print suppress and data pass-through**
ASCII [ESC] < <n>
Hexadecimal 1BH 3CH <n>
Decimal <27> <60> <n>
IPCL &%PT <n>
EPOS [ESC] = <n>
Description The command provides print suppress and data pass-through features.

Where:	Bit 0	Printer select
	Bit 1	Pass-through - - on
	Bits 2-7	Undefined

If Bit 0 is clear, the printer will stop processing data. If Bit 1 is set, the data will be passed through the printer and be sent out on the serial port.
Notes
1. The pass-through command is processed as part of the print data. The data are not processed until they are found in the input buffer by the print processor. They are not immediate commands. The printer must be on-line and ready to activate the command.
2. If the printer is configured for parallel operation, the data will still pass-through on the serial port. The serial port is not generally connected.
3. The operation of the command can be altered by the print suppress configuration and requires that the pass-through and print-suppress functions be enabled in the configuration menu.
4. These commands do not function if M50 compatibility is turned on. M50 pass-through must be used.
5. Multidrop is operational during suppress and pass-through. If a multidrop address in present in the pass-through data, it will be processed.

Function	**Control Feature Commands**
ASCII	[ESC] y <n>
Hexadecimal	1BH 79H <n>
Decimal	<27><121><n>
IPCL	&%Y0 through 9 or &%YX <m_1><m_2><m_3> (for numbers greater than 9)
EPOS	[ESC]y<n>

Where n:

0	Disables quiet mode operation
1	Enables quiet mode operation
2	Reinitializes the printer and forces IBM mode
3	Reinitializes the printer and forces EPOS mode
4	Disables IPCL commands
5	Enables IPCL commands (Note: Once disabled, the command will not be a valid IPCL code).
6	Disables ENQ processing
7	Enables ENQ processing
8	Enables extended diagnostics
11	Overlays the current character chart with Group 2 OCR MA characters
12	Replaces the OCR characters with the normal characters
128+	Sets Windows control flags
10000001	Disables the next eject command which allows Windows drivers to do station-select commands with paper-source selections. This is reset after it is used.
10000010	Disables the next knife-cut command
10000100	Flags a MICR operation from Windows
10001000	Not defined
10010000	Causes the next slip select to ignore the form sensors
10100000	Causes next receipt select to ignore the form sensors when in receipt mode
11000000	Not defined

Description

The command enables and disables command set features.
It is possible that the IPCL commands will interfere with the print data. If this is the case, they can be disabled with an [ESC] y <4>.

Notes

1. Quiet mode operation prints by making two passes for every pass in normal mode. It generates less noise because only half the print wires are activated in each pass. Quiet mode is very slow and should only be used if quiet operation is needed.
2. ESC y <2> and <3> allow the printer to be switched between Normal and EPOS modes. When the switch takes place, the current print buffer is printed, and the printer reinitializes. These commands do not permanently change the configuration. A power on reset will restore the mode that was configured in menu mode. A reset by command or from the INIT pin will not restore the mode.
3. ESC y <6> and <7> enable and disable the inquire processing. These commands are not processed as they are received, but are buffered and then processed. Because of this, [ENQ] commands sent after a disable may be answered. In addition, [ENQ]s sent after an enable may not be replied.
4. The printer has a resident OCR-MA font that only works in utility mode and only contains Group 2 characters. They are defined and mapped per ANSI X3.111-1986. Once mapped into a code page, they can be removed by issuing an [ESC]y<12> command or a code-page select command.

EPOS note The [ESC]y command is active in EPOS mode; however, Modes 5 and 6 are disabled.

Windows Windows drivers to temporarily disable or alter select commands use Windows control flags. Windows print drivers are based on non-POS printers. To allow these drivers to better operate in a POS environment, the printer can be instructed to ignore or alter the operation of select commands on the next occurrence. This command should not be used by typical applications.

Function **Enable dynamic response**
ASCII [ESC] w <n>
Hexadecimal 1BH 77H <n>
Decimal <27><119><n>
IPCL none
EPOS [GS]a<n>
Where n defines the features that cause dynamic responses:

Bit 0	Cash Drawer 0	ACK/NAK <1>
Bit 1	Cash Drawer 1	ACK/NAK <2>
Bit 2	Paper-out status	ACK/NAK <4>
Bit 3	Form-in sensor	ACK/NAK <5>
Bit 4	Paper-low sensor	ACK/NAK <3>
Bit 5	Form-present sensor	ACK/NAK <6>
Bit 6	Form-clamp status	ACK/NAK <7>
Bit 7	Cover status	ACK/NAK <8>

Dynamic status can be used to allow the host to sense status changes without sending repeat ENQ commands. The operation of the dynamic response varies depending on the configuration of the printer. If the printer is configured for serial or parallel, IEEE 1284 operation, more than one status can be sensed because the printer will respond to status changes as if an [ENQ] were issued. In parallel mode, only one status should be requested. If more than one bit is active, the result status on the PE signal is not defined.

Note Power up default is paper out on PE signal.

Function **Multidrop control**
ASCII [SOH] <n>
Hexadecimal 01H <n>
Decimal <1> <n>
IPCL none
Where <n> is the printer address. Addresses of A, B, or C are configurable.
In multidrop mode, the printer must be addressed. This is the addressing command. If the printer is configured with an address of “A”, the printer will operate when addressed. When any other address is sent to the printer, it will enter print suppress mode. An address of “Z” is a universal address and will always activate the printer.

5.14 M50 Compatibility Commands

To allow the M90PLUS printer to replace the M50 printer without effecting the M50 printer's application, several special M50 commands are available in the M90PLUS printer as M50 extensions. Because these commands can have effects that M90PLUS applications may not want, these commands must be enabled.

To make the M50 commands operational, enable the M50 extensions in the configuration menu.

Function	**Extended M50 cash drawer commands**
ASCII	[BS]
Hexadecimal	08H
Decimal	<8>
Description	The command opens Cash Drawer 1.

Function	**Extended M50 cash drawer commands**
ASCII	[BEL]
Hexadecimal	07H
Decimal	<7>
Description	The command opens Cash Drawer 2.

Function	**Extended M50 cash drawer commands**
ASCII	[ESC]+
Hexadecimal	1BH,2BH
Decimal	<27><43>
Description	The command opens Cash Drawer 1.

Function	**Extended M50 pass-through**
ASCII	[ESC]# or [ESC] d or [ESC][RS] and [ESC]"
Hexadecimal	1BH,23H or 1BH,64H or 1BH,1EH and 1BH,22H
Decimal	<27><35> or <27><100> or <27><30> and <27><34>
Description	[ESC]# or [ESC]d turn on pass-through, and [ESC][RS] or [ESC]" turn it off. This command requires that the pass-through function be enabled in the configuration menu.

5.15 Printer Status Set/Inquire

The Series 90PLUS printer is designed to be used as part of an automated system where the host computer makes every attempt to correct problems with the printer. In addition, the host application requires that it be able to obtain more information from the printer than is typical of normal computer printers. A normal computer printer does not have cash drawers and slip stations. As a result, the standard printer protocol must be extended to deal with the additional features of a POS printer.

The Series 90PLUS printer has defined a set of status-inquiry commands that will allow a host to obtain information about the printer and devices connected to it. The method chosen to interact with the computer is designed to allow a reasonable approach to the host application. It will not always be possible for an existing application to use the ENQ commands unless the communication drivers are available to the programmer.

All ENQ commands require a response from the printer. For this reason, the parallel, non-IEEE 1284; parallel, IEEE 1284; and serial operation of ENQ commands are different. In serial and parallel, IEEE 1284 modes, all ENQ commands are responded to by ACK or NAK and then the command ID. In parallel, non-IEEE 1284 operation, the paper-error (PE) signal is driven as a response to an ENQ.

5.15.1 Parallel, Non-IEEE 1284 Mode Inquire

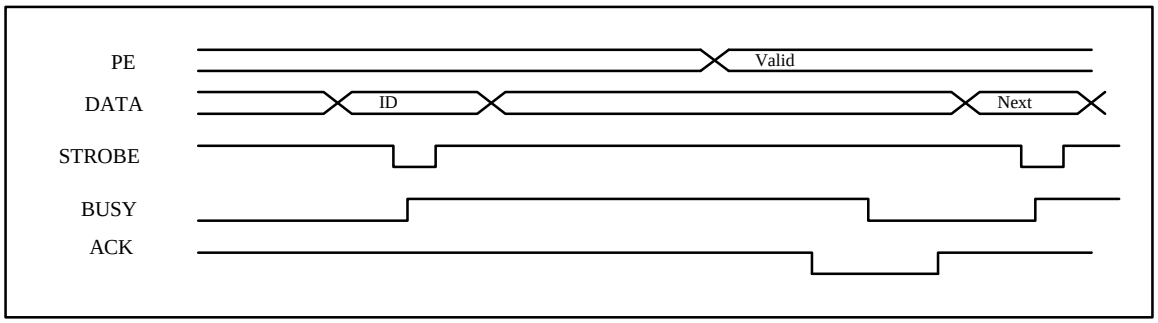
There are several status inquiry commands and ENQ control commands. The ENQ character is treated differently from all other characters received by the printer. Under normal operating conditions, all information that is sent to the printer is received and placed in a holding buffer. The information stays in the holding buffer until the printer prints or interprets it.

In parallel, non-IEEE 1284 operation there is no easy way to return complex information to the host. For this reason, the PE signal is used for inquire responses. The FAULT signal will not be asserted by inquire requests. If a true PE is being signaled, the FAULT line will also be driven. It is, therefore, possible to distinguish between a paper-error and an ENQ response.

In parallel mode, the printer will respond to the ENQ before the parallel sequence is complete. In other words, when the parallel port acknowledges the ID part of the ENQ sequence, the PE signal will be valid. The host must, however, remember what status was requested as the printer has no way of signaling that information. In addition, the host must not interpret the PE signal as an error but as a response to an ENQ.

There are two modes in which inquire responses can be signaled. These two modes result in either a dynamic or static PE. When a dynamic PE occurs, the inquiry is sent once, and the PE signal follows the requested status. If PE remains static, the status does not change.

Receipt-paper status is always dynamic. If the PE signal is to be returned to the valid paper-error state, an [ENQ]<4> should be issued when all other inquires are completed.



PE to ENQ request timing

5.15.2 Serial Mode Inquire

All ENQ commands require a response from the printer. In serial operation, all ENQ commands are responded to by ACK or NAK, the command ID, and in some cases status.

The serial ACK or NAK responses are always uniform and followed with a command ID. This makes the design of the host application easier.

The printer will always accept serial data. If the printer is off-line, the serial data is still accepted. It is possible to send inquire commands to the printer even when it is off-line. Because ENQ commands are processed before they go in the buffer, the printer will respond even when it is busy.

In serial mode, it is desirable that the response to an ENQ be received by the host before another ENQ command is issued to the printer. When the printer receives an ENQ, it must generate a response. If ENQ's are sent to the printer too fast, the printer will spend all of its time responding to ENQ's and have no time to print.

5.15.3 Parallel, IEEE 1284 Mode Inquire

In parallel, IEEE 1284 mode, there is a way to return status information to the host. After the host makes an ENQ request, the host can activate parallel, IEEE 1284 Mode 0, reverse-channel and wait for a response from the printer. The response to the ENQ is identical to serial mode.

The printer will always accept parallel, IEEE 1284 reverse-channel requests but will not accept ENQ commands when it is off-line. It is possible to obtain status when off-line by placing the printer in dynamic response mode before the printer goes off-line. The IEEE 1284 reverse-channel will then respond to status changes even if the printer is off-line. It is also possible to configure the printer so that it will not go off-line in most cases. Power off, paper out, and faults will always generate off-line status.

5.15.4 Dynamic Response Mode

Dynamic status, [ESC]w<n>, can be used to allow the host to sense status changes without sending repeat ENQ commands. The operation of the dynamic response varies depending on the configuration of the printer. If the printer is configured for serial or parallel, IEEE 1284 operation, more than one status can be sensed as the printer will respond to status changes as if an [ENQ] were issued. In parallel mode, only one status should be requested. If more than one-bit is active, the result status on the PE signal will not be defined.

The reply to dynamic responses is the same as inquire commands. That is, if the cash drawer status is to be sensed, the PE or ACK/NAK will be the same as for inquire commands.

5.15.5 Inquire Commands

ENQ commands are as follows.

Function	**Inquire printer status**
ASCII	[ENQ] <n>
Hexadecimal	05H <n>
Decimal	<5><n>
IPCL	none
EPOS	[GS] r or [DLE] [ENQ] or [DLE] [EOT]
Description	The command inquires as to the printer's status and returns the result. The following ENQ's are defined.
Note	If the printer is off-line, the ENQ may not be accepted.

Function	**Inquire Cash Drawer 1 status**
ASCII	[ENQ] <1>
Hexadecimal	05H 01H
Decimal	<5><1>

Function	**Cash Drawer 1 status**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <1> (06H 01H) Cash Drawer 1 is closed.	PE low
	NAK <1> (15H 01H) Cash Drawer 1 is open.	PE high
Note	When the circuit is open, the drawer is closed.	

Function	**Inquire Cash Drawer 2 status**
ASCII	[ENQ] <2>
Hexadecimal	05H 02H
Decimal	<5><2>

Function	**Cash Drawer 2 status**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <2> (06H 02H) Cash Drawer 2 is closed.	PE low
	NAK <2> (15H 02H) Cash Drawer 2 is open.	PE high
Note	When the circuit is open, the drawer is closed.	

Function	**Inquire receipt-paper low**
ASCII	[ENQ] <3>
Hexadecimal	05H 03H
Decimal	<5><3>

Function	**Receipt-paper low**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <3> (06H 03H) There is receipt paper.	PE low
	NAK <3> (15H 03H) The receipt paper is low.	PE high

Function	**Inquire receipt-paper out**
ASCII	[ENQ] <4>
Hexadecimal	05H 04H
Decimal	<5><4>

Function	**Receipt-paper out**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <4> (06H 04H) There is receipt paper.	PE low
	NAK <4> (15H 04H) The receipt paper is exhausted.	PE high

Function	**Inquire Slip-sensor Status**
ASCII	[ENQ] <5>
Hexadecimal	05H 05H
Decimal	<5><5>

Function	**Is the slip-sensor detecting a form?**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <5> (06H 05H) No form is present.	PE low
	NAK <5> (15H 05H) Form is present.	PE high

Function	**Inquire form position sensor status**
ASCII	[ENQ] <6>
Hexadecimal	05H 06H
Decimal	<5><6>

Function	**Is the form position sensor detecting a form?**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <6> (06H 06H) The position sensor is clear. (No form is present).	PE low
	NAK <6> (15H 06H) The form position sensor is blocked. (There is a form).	PE high

Function **Inquire form-clamp status**
ASCII [ENQ] <7>
Hexadecimal 05H 07H
Decimal <5><7>

Function **Inquire whether the form-clamp is closed**

	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <7> (06H 07H) The clamp is closed.	PE low
	NAK <7> (15H 07H) The clamp is not closed. (It is in open or jam position).	PE high

Function **Inquire cover-open status**
ASCII [ENQ] <8>
Hexadecimal 05H 08H
Decimal <5><8>

Function **Inquire whether the cover is closed**

	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <8> (06H 08H) The cover is closed.	PE low
	NAK <8> (15H 08H) The cover is open.	PE high

Function **Is the buffer empty? Clear the parallel, IEEE 1284 buffer.**
ASCII [ENQ] <9>
Hexadecimal 05H 09H
Decimal <5><9>

Function **The command allows the host to know when the print buffer is empty. If IEEE 1284 is active, the command also clears the response buffer.**

	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <9> (06H 09H) The buffer is empty.	PE low
	NAK <9> (15H 09H) The buffer is not empty.	PE high

Function	**Request printer reset**
ASCII	[ENQ] <10>
Hexadecimal	05H 0AH
Decimal	<5><10>

Function	**Reset Printer**	
	Serial	**Parallel mode**
Response	ACK <10> (06H 0AH) The command was accepted. NAK <10> (15H 0AH) The command was rejected.	No response in parallel mode.
Description	The ENQ <10>, EPOS "DLE ENQ n" commands, and the INIT pin all have the same effect and are termed "Reset" commands. To prevent data loss, the printer will try to finish printing any buffered data. This will fail if operator intervention with the printer is required. The reset operation is saved until the printer goes idle. In the case of the slip request command or any command that waits for the operator, the printer is idle. If the printer is idle and a reset is received or is pending, the printer will reset, and the buffer will be cleared. If the host resets an operator intervention operation, any remaining buffered data will be cleared. When the printer receives a reset command, the printer will go off-line and/or show a busy signal until the reset completes. In serial mode, the printer can have information in its high-speed buffer that was received after the reset command was issued, but before it was processed. If the host application continues to send information to the printer after a reset command, some of that information may be processed before the reset is processed. In parallel mode, the printer will go busy after the reset is received and before the next byte is accepted. The printer will accept an [ENQ]<10> in parallel mode. It will not be acknowledged, however. If both the serial and parallel ports are active, the serial reset will not be acknowledged either because the reset operation will remove the parallel response. In parallel, IEEE 1284 mode, the response buffer is cleared by a reset command preventing responses in IEEE 1284 mode as well.	
Note	There is a menu selection that will block the command. If reset inhibit is set in the configuration menu, the command will be ignored.	

Function	**Inquire power-cycle status**
ASCII	[ENQ] <11>
Hexadecimal	05H 0BH
Decimal	<5><11>

Function	**Has the printer been power-cycled since the last request?**	
	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	ACK <11> (06H 0BH) Printer power has been cycled since the last [ENQ] <11>.	PE low
	NAK <5> (15H 0BH) Printer has not power-cycled since the last [ENQ] <11>.	PE high
Description	The first time after a reset, the command will return [ACK] <11>, after that the command will return [NAK] <11>. The command allows the application to determine if the printer has been power-cycled and needs to be reinitialized. The [ENQ] <10> command and the INIT signal on the parallel port will both cause the printer to return power-up status.	

Function	**MICR read cancel**
ASCII	[ENQ] <12>
Hexadecimal	05H 0CH
Decimal	<5><12>
IPCL	none
Description	The [ENQ] command is a real-time command that forces a MICR read command to stop and return no data. The command can be used to get the printer out of a read command. It has no other effect on the printer and is always acknowledged. (See another ENQ command for a description). If the read is complete before the ENQ <12> is issued, the read command will operate normally.

Function	**Inquire printer state**
ASCII	[ENQ]<15>
Hexadecimal	05H 11H
Decimal	<5><15>

Function **Returns current printer state**

	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	[ACK]<15><n><r1><r2>…	not supported via PE

Where <15> is the echo of command ID
n = number of return bytes + 40 (28H)
(to prevent confusion with XON/XOFF).

<r1>:
- Bit 0 = Form-clamp closed
- Bit 1 = Cover closed
- Bit 2 = Receipt-paper out
- Bit 3 = Front-slip sensor detects paper
- Bit 4 = In error state (Waiting for error to be cleared)
- Bit 5 = Top form sensor detects paper
- Bit 6 = 1 always
- Bit 7 = 0 always

<r2>: Form processing state

040H	No form processing
042H	Waiting for a slip or for a slip to be cleared
044H	Waiting to enter validation mode or waiting for the paper path to be cleared to enter validation mode
046H	Waiting for a slip to be removed to enter receipt mode
041H	Waiting for the slip path to be cleared
043H	Slip mechanism in error mode (autoclears)
045H	Waiting for an internal-delay time out (autoclears)
048H	MICR process starting (autoclears)
049H	MICR waiting for a check to be inserted
04AH	MICR reading the check (autoclears)
04BH	MICR translating the MICR data (autoclears)
04FH	MICR process in error (requires operator intervention to clear)

Other states may be active but will automatically be cleared.

Note [ENQ]<17> is valid for this function but should not be used as it conflicts with XON/XOFF flow control.

Function	**Inquire all printer status**
ASCII	[ENQ]<20>
Hexadecimal	05H 14H
Decimal	<5><20>

Function **Returns all status flags**

	Serial/Parallel, IEEE 1284	Parallel, IEEE 1284
Response	[ACK]<20><n><r1><r2>…	not supported via PE

Where <20> is echo of command ID

n = number of return bytes + 40 (28H) (to prevent confusion with XON/XOFF).

<r1>:
- Bit 0 = Cash Drawer 1 open
- Bit 1 = Cash Drawer 2 open
- Bit 2 = Receipt-paper out
- Bit 3 = Front slip-sensor detects paper
- Bit 4 = Receipt-paper error
- Bit 5 = Top form sensor detects paper
- Bit 6 = 1 always
- Bit 7 = 0 always

<r2>:
- Bit 0 = Form-clamp closed
- Bit 1 = Cover closed
- Bit 2 = Buffer empty
- Bit 3 = Printer power has been cycled. (It does not affect the state of the power-cycled flag. Use [ENQ]<11> to reset).
- Bit 4 = Printer in error mode
- Bit 5 = Printer is waiting for some type of slip operation.
- Bit 6 = 1 always
- Bit 7 = 0 always

<r3>:
- Bit 0 = Receipt station selected
- Bit 1 = Top validation station selected
- Bit 2 = Front slip station selected
- Bit 3 = Waiting for form
- Bit 4 = Undefined
- Bit 5 = Printer is blocking print. (Cover is open or out of paper).
- Bit 6 = 1 always
- Bit 7 = 0 always

<r4>:
- Bit 0 = Printer supports receipt
- Bit 1 = Printer supports inserted forms
- Bit 2 = Undefined
- Bit 3 = Printer supports cutter
- Bit 4 = Printer supports partial cuts
- Bit 5 = Printer supports MICR
- Bit 6 = 1 always
- Bit 7 = 0 always

Function	**Inquire printer ID**
ASCII	[ENQ]<21>
Hexadecimal	05H 15H
Decimal	<5><21>

Function **Returns printer parallel, IEEE 1284 ID string**

	Serial/Parallel, IEEE 1284	**Parallel, non-IEEE 1284**
Response	[ACK]<21><n>{{ID string}	not supported via PE

Where <21> is the echo of command ID
<n> = number of return bytes in the ID string
{ID string} is the IEEE ID return string, which is as follows:
MFG:Ithaca-Periph.;
CMD:M90CL,IPCL;
CLS:PRINTER;
MDL:S90 PcOS;
DES:Ithaca-Peripherals Series 90;
REV:02.20;
OPTS:$91xy
Where x is a bit field defined as follows:

- Bit 0 = Narrow print zone
- Bit 1 = 0 not defined
- Bit 2 = 0 not defined
- Bit 3 = Always 0
- Bit 4 = Always 1
- Bit 5 = Always 1
- Bit 6 = Always 0
- Bit 7 = Always 0

and y is a bit field defined as follows:

- Bit 0 = Slip capability
- Bit 1 = Knife installed
- Bit 2 = MICR installed
- Bit 3 = Always 0
- Bit 4 = Always 1
- Bit 5 = Always 1
- Bit 6 = Always 0
- Bit 7 = Always 0

5.16 Extended Diagnostics Commands

Function	**Extended diagnostics**	
ASCII	[ESC] ~ <n>	
Hexadecimal	1BH 7EH	
Decimal	<27><126>	
IPCL	none	
EPOS	[ESC]~<n>	
	Where n: 0	Prints model, configuration, and serial number
	1 <n>	Sets vertical alignment (where <n> is the alignment value) Note: n will be written to the EEPROM if the EEPROM save sequence is processed.
	2	Decreases vertical alignment adjustment
	3	Increases vertical alignment adjustment
	4	Prints a vertical adjustment alignment chart
	[ACK]	Returns configuration synchronization code
	C <a><d>	Changes EEPROM data at <a> to <d> (pass-code locked)
	D	Returns menu to default (pass-code locked)
	I	Returns ROM ID
	N <l><h>	Forces a MICR speed calibration
	M	Sets the MICR calibration from the last calibration document read. This command is intended to be part of the self-test MICR calibration procedure.
	X	Defines and writes the MICR translation table to the EEPROM This command follows the same pattern as the [ESC]mX command defined above.
	F	Resets the MICR calibration and translation table configuration back to default
	L <adr> <cmd> <len> <data ...>	MK Link Diagnostics
	P	Forces parallel, IEEE 1284 mode (This does not alter menu RAM).
	R	Reads and returns the menu RAM
	S	Forces serial mode (This does not alter menu RAM).
	T	Clears the totals (pass-code locked)
	W	Writes menu RAM back to EEPROM (pass-code locked)
	Z	Halts the software
	[CAN]	Forces the printer to power-cycle
	N <l><h>	Forces a MICR speed calibration
	M	Sets the MICR calibration from the last cal document read
	X	Defines and writes the MICR translation table to the EEPROM
	F	Resets the MICR calibration and translation table configuration back to default

Description

The extended diagnostic commands are designed to be used by Ithaca Peripherals to help adjust and test the printer. There is no guarantee that these commands are valid and/or stable. They are not intended for use by the end user. To prevent accidental use of these commands, they must be enabled by an [ESC]y<8> command. In some cases, a pass-code sequence is also required.

Write EEPROM

The EEPROM command allows specific menu RAM locations to be written. The definition of the locations is not defined here. This command is intended for use by Ithaca Peripherals and is only active if a pass code is sent to the printer.

5.17 EPOS Codes

This section lists the EPOS codes that are supported by the Series 90PLUS printer. Ithaca Peripherals has no control over of how Epson extends or changes these control codes. Ithaca Peripherals makes no guarantees as to the operation of our printer when it replaces an Epson printer. The EPOS emulation is intended to make it as easy as possible to replace an Epson printer with an Ithaca Series 90PLUS printer.

The following section lists all EPOS commands that are processed. They are as close as possible to the Epson printers. The user must remember that the Series 90PLUS printer is not designed as a drop-in replacement for an Epson printer. The Ithaca Peripherals' Series 90PLUS printer is designed to bring new and unique features and functionalities to a POS receipt/validation printer.

5.17.1 Real-time Status

The Series 90PLUS printer is available in serial and parallel versions. When Epson supports parallel operation, the company redefines some of the standard IEEE 1284 interface signals to be special status lines. The Series 90PLUS printer does not alter the IEEE 1284 Standard. If an application requires real-time status from the printer, the IEEE 1284 bidirectional protocol must be used.

The Series 90PLUS printer supports real-time status. The EPOS real-time status commands [DLE] [ENQ] and [DLE] [EOT] are processed by the printer. The printer, however, does not support all the response bit fields. See the descriptions below.

5.17.2 EPOS Command Summary

Please refer to the Epson ESC/POS Information Manual for field definitions.

The following is a list of the EPOS commands that are supported:

Command	Description	Comment
[VT]	Vertical tab	Extension
[LF]	Linefeed	
[FF]	Eject form	
[HT]	Horizontal tab	Extension
[BS]		Extension
[CR]	Carriage return	
[DEL] [EOT] <n>	Real-time status request	Not the same
[DEL] [ENQ] <n>	Real-time command	Not the same
[CAN]	Cancel print	Not the same
[ESC] SI	Set 24 cpi	Extension
[ESC][SP] <n>	Set right-side character spacing	
[ESC] ! <n>	Select print modes	
[ESC] $ <nl> <nh>	Set absolute print position	
[ESC] % <n>	Not implemented	

Command	Description	Comment
[ESC] & ...	Not implemented	
[ESC] * <m> <n>1 <n>2	Select single-density bit image mode	Extended
[ESC] - <n>	Turn underline mode ON/OFF	
[ESC] <	Return home (not necessary with the Series 90PLUS)	
[ESC] = <n>	Select peripheral device (pass-through)	Not the same
[ESC] ? <n>	Cancel used defined characters (not implemented)	
[ESC] 0	Set eight line per inch spacing	
[ESC] 1	Set 7/72 inch spacing	
[ESC] 2	Set six line per inch spacing	
[ESC] 3 <n>	Set line spacing	
[ESC] 4	Italic mode set	Extension
[ESC] 5	Italic mode reset	Extension
[ESC] <	Print one-line unidirectional (similar to EPOS)	
[ESC] =	Select peripheral device	
[ESC] ?	Cancel user defined characters (ignored)	
[ESC] @	Initialize printer	
[ESC] B <n>1 <n>2 <n>3 ... <n>i 0	Set vertical tab stops	Extension
[ESC] C <n>	Set form length (similar to EPOS)	
[ESC] D <n>1 <n>2 <n>3 ... <n>i 0	Set horizontal tab stops	Extension
[ESC] E <n>	Turn emphasize ON/OFF	
[ESC] G <n>	Turn double-strike mode ON/OFF	
[ESC] J <n>	Print and feed	
[ESC] K <n>	Print and reverse feed	Not implemented
[ESC] L	Page-mode select (sets top of page for [FF] command)	Not implemented
[ESC] M	Set 12 cpi character spacing	
[ESC] P	Set 10 cpi character spacing	
[ESC] Q <n>	Right margin set in characters	
[ESC] R <n>	Select International Character Set	Extended
[ESC] T <n>	Select print direction	Similar
[ESC] U <n>	Turn unidirectional ON/OFF	
[ESC] V <n>	Turn rotate-clockwise mode ON/OFF	Similar
[ESC] W ...	Set printing area in page mode	Not implemented
[ESC] [<m><n>	Select code-page/print feature (same as normal mode)	

Command	Description	Comment
[ESC] \ <nL> <nH>	Set relative print position	
[ESC] ^ ...	Epson 9-pin bit image	
[ESC] a <n>	Left, center, and right justify	
[ESC] b <n>	Print bar code (same as normal mode)	
[ESC] c <m> <n>	Select station (See description below).	Similar
[ESC] d <n>	Feed <n> lines	
[ESC] f <t1> <t2>	Set wait time (See description below).	Similar
[ESC] g <n>	Graphic-save (same as normal mode)	Extension
[ESC] j	Reverse linefeed	
[ESC] l <n>	Left margin set in characters *	
[ESC] p <m> <t1> <t2>	Generate pulse (See description below).	Similar
[ESC] q	Release	
[ESC] t <n>	Select character code table (Katakana and space page are not supported).	Similar
[ESC] u <n>	Return status of cash drawer (serial and parallel, IEEE 1284 only)	
[ESC] v	Transmit paper status (similar to Epson, serial, and parallel, IEEE 1284 only)	Similar
[ESC] x <n>	Set print font (same as Normal [ESC]I <n>)	Extension
[ESC] { <n>	Turn upside down print ON/OFF	
[ESC] ~ <n>	Test mode diagnostic commands	Extension
[GS] * ...	Define download bit image	Not implemented
[GS] /	Print download bit image	Not implemented
[GS] E <n>	Set impact energy (available during validation only)	
[GS] I <n>	Transmit specified ID (different than Epson)	
[GS] L ...	Set left margin in 1/160 inch	
[GS] P ...	Fundamental units are fixed at 1/144 and 1/160 inch.	Not implemented
[GS] W ...	Select printable area in 1/160 inch	
[GS] a <n>	Turn ON/OFF automatic status back	
[GS] h <n>	Set bar code height	Extension
[GS] k <m> ... <0>	Print bar code	Extension
[GS] r <n>	Read status	Similar

5.17.3 EPOS Deviations

There are several important differences between the M90PLUS and Epson printers. The closest Epson models to the M90PLUS printer are the TM370 or TM375 printers. An application that takes full advantage of the Epson printer will require some modification to use an M90PLUS printer. The biggest differences between the TM370 and M90PLUS printers can be grouped into three areas.

The first is mechanical. The M90PLUS printer has a larger print zone than the TM370 printer, and the top and bottom form limits are slightly different. In addition, the receipt paper is wider in the M90PLUS printer, and the larger print zones allow more characters to be printed.

The second is page mode. The M90PLUS printer does not implement page mode the same way as the TM370 printer. If the application uses page mode, it may have to be changed. The biggest difference between the TM370 and M90PLUS printers is that the M90PLUS printer only buffers print information in 90° and 270° rotated print. In addition, the M90PLUS printer does not allow the rotation mode to be switched during format development.

The third major difference is that the M90PLUS printer does not implement real-time status responses in the same way that the TM370 printer does. Several bit definitions are slightly different.

5.17.3.1 Command Descriptions

Function **Eject slip**
ASCII [FF]
Description The M90PLUS printer does not support page mode. The printer will eject a form in slip or validation mode. If in receipt mode, it will do a normal form feed.

Function **Real-time status**
ASCII [DEL] [EOT]
Description The M90PLUS printer does not support real-time status.

Function **Cancel print data**
ASCII [CAN]
Description The M90PLUS printer uses [CAN] to clear the printer line buffer.

Function **Return home**
ASCII [ESC] <
Description The M90PLUS printer does not need this command. The M90PLUS printer never loses track of the print head. The effect of this command is to set the next print line to print from left to right.

Function **Select peripheral device**
ASCII [ESC] = <n>
Description The M90PLUS printer does not support the Epson pole display. This command provides print-suppress and data pass-through functions.

Where:		
	Bit 0	Printer select
	Bit 1	Pass-through
	Bits 2-7	Undefined

Function **Set form-length**
ASCII [ESC] C <n>
Description The M90PLUS printer uses this as a set form-length command.

Function **Select page mode**
ASCII [ESC] L
Description The M90PLUS printer does not implement page mode. This command sets the top of the form.

Function **Set print direction**
ASCII [ESC] T <n>
Description The M90PLUS printer does not implement page mode. This command uses the normal rotated print format procedures. See [ESC] r <n> in normal mode.
Note EPOS reverses Modes 1 and 3.

Function **Print graphics**
ASCII [ESC] * <m> ...
Description The M90PLUS printer defines the extended graphic modes. Mode 4 is normally 80 dpi. The M90PLUS printer does not support 80 dpi. If Mode 4 is selected, 72 dpi will be used.

Function **Turn 90° clockwise font ON/OFF**
ASCII [ESC] V <n>
Description The M90PLUS printer uses the rotated 90° font to implement this command. If 1 dot spacing is selected, 10 cpi is used. If 1.5 dot spacing is selected 8 cpi is used.

Function **Select print paper**
ASCII [ESC] c 0 <n>
Description The M90PLUS printer uses this command to select a print station. The M90PLUS printer does not keep track of different settings for each mode. If a specific print mode is required, it must be respecified.

Function **Select print paper for settings**
ASCII [ESC] c 1 <n>
Description The M90PLUS printer does not keep track of different settings for each mode. If a specific print mode is required, it must be respecified.

Function **Select detectors to stop printing**
ASCII [ESC] c 4 <n>
Description The M90PLUS printer does not stop at the end of forms. The application must keep track of form length.

Function **Enable/disable panel buttons**
ASCII [ESC] c 5 <n>
Description The M90PLUS printer does not allow the front panel to be disabled.

Function **Generate pulse**
ASCII [ESC] p <m> <t1> <t2>
Description The M90PLUS printer does not allow the cash drawer pulse to be altered under software control. The <t1> <t2> parameters are ignored. <m> selects Drawer 1 or 2.

Function **Transmit paper status**
ASCII [ESC] v
Description The M90PLUS printer returns a status similar to EPOS.
The return byte is defined as follows:

Bit 0	Paper low
Bit 1	Paper low
Bit 2	0
Bit 3	0
Bit 4	0
Bit 5	Lower form sensor
Bit 6	Lower form sensor
Bit 7	0

Function **Set impact energy**
ASCII [GS] E <n>
Description The M90PLUS printer allows higher impact energy in slip and validation modes only.

Function **Transmit specified ID**
ASCII [GS] I <n>
Description The M90PLUS printer always returns 0 for all ID's.

Function **Transmit status back**
ASCII [GS] r <n>
Description The M90PLUS printer returns a status similar to EPOS.
The <n> byte is defined as follows:

1 = Transmit paper status

Bit 0	Paper low
Bit 1	Paper low
Bit 2	0
Bit 3	0
Bit 4	0
Bit 5	Lower form sensor
Bit 6	Lower form sensor
Bit 7	0

2 = Transmit cash drawer status

Bit 0	Cash Drawer 1 status
Bit 1	0
Bit 2	0
Bit 3	0
Bit 4	0
Bit 5	0
Bit 6	0
Bit 7	0

Function **Automatic status back**

ASCII [GS] a <n>

Description The M90PLUS printer returns a status similar to EPOS.

The <n> byte is defined as follows:

Bit 0	Cash Drawer 1
Bit 1	Cover open/closed
Bit 2	-
Bit 3	Paper low/out
Bit 4	-
Bit 5	Form sensors
Bit 6	-
Bit 7	-

The four return bytes are as follows.

Byte 1 is defined as follows:

Bit 0	0
Bit 1	0
Bit 2	Cash Drawer 1
Bit 3	On-line/off-line
Bit 4	1
Bit 5	Cover open/closed
Bit 6	LF switch state
Bit 7	0

Byte 2 is defined as follows:

Bit 0	0
Bit 1	0
Bit 2	0
Bit 3	0
Bit 4	0
Bit 5	0
Bit 6	0
Bit 7	0

Byte 3 is defined as follows:

Bit 0	Paper low
Bit 1	Paper low
Bit 2	0
Bit 3	0
Bit 4	0
Bit 5	Upper form sensor
Bit 6	Lower form sensor
Bit 7	0

Byte 4 is defined as follows:

Bit 0	Slip mode
Bit 1	Lower form sensor
Bit 2	Validation mode
Bit 3	Upper form sensor
Bit 4	0
Bit 5	Upper form sensor
Bit 6	Lower form sensor
Bit 7	0

Function **Set bar code height**
ASCII [GS] h <n>
Description Set the bar code height in dot lines. The Series 90PLUS printer prints bar codes in 8-dot passes in graphics. The height used in EPOS is intended for thermal printers. To allow some compatibility between EPOS and the Series 90PLUS printer, the value of n is divided by 28. This allows a similar size bar code to be printed.
Note Values less than 28 return the printer to the default values defined by the [ESC][EM]B command in normal mode.

Function **Set bar code**
ASCII [GS] k <m> {information} [NUL]
Description The Series 90PLUS printer uses the same print functions to print EPOS bar codes as the normal mode bar codes.
EPOS has two formats for bar codes. One is [NUL] terminated; the other has a length field. If <m> is greater than 64, the next byte sets the length in bytes. Only the [NUL] terminated command is supported by the Series 90PLUS printer.

Where m:	0	UPC A	Numeric (0-9) only; 11 digits
	1	UPC E	Numeric (0-9) only; 11 digits
	2	EAN-13	Numeric (0-9) only; 12 digits
	3	EAN-8	Numeric (0-9) only; 6 digits
	4	Code 39	26 uppercase letters (A-Z); 10 digits (0-9)
	5	Interleaved 2 of 5	Numeric (0-9) only, must be even number of digits

Note If Code 128 is to be printed, it must be printed with the [ESC] b <n> command as described on page 53.

Function **Real-time command**
ASCII [DLE][ENQ] <n>
Description The Series 90PLUS printer only supports Commands 2 and 3. Both have the same effect and reset the printer.
Unlike Epson, this command is filtered out of all other commands. If the [DEL] [ENQ] <n> is part of some other command (like graphic data), it will have no effect.

Function **Real-time status request**

ASCII [DLE] [EOT] <n>

Description The Series 90PLUS printer supports Commands 1 through 6. The returned status is not identical to the Epson printer.

Unlike Epson, this command is filtered from all other commands. If the [DEL] [EOT] <n> is part of some other command, it will have no effect.

<n> = 1 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	Cash Drawer 1
Bit 3	On-line/off-line
Bit 4	1
Bit 5	0
Bit 6	0
Bit 7	0

<n> = 2 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	Cover state
Bit 3	0
Bit 4	1
Bit 5	Paper out
Bit 6	Error
Bit 7	0

<n> = 3 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	0
Bit 3	0
Bit 4	1
Bit 5	0
Bit 6	Head temp
Bit 7	0

<n> = 4 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	Paper low
Bit 3	Paper low
Bit 4	1
Bit 5	0
Bit 6	0
Bit 7	0

<n> = 5 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	Slip-station selected
Bit 3	Waiting for slip
Bit 4	1
Bit 5	No slip detected
Bit 6	No slip detected
Bit 7	0

<n> = 6 is defined as follows:

Bit 0	0
Bit 1	1
Bit 2	Validation-station selected
Bit 3	Validation waiting for slip
Bit 4	1
Bit 5	No validation slip detected
Bit 6	No validation slip detected
Bit 7	0

5.18 Control Codes Summary by Code

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[NUL]		00		Null	
[SOH]	<addr>	01H		Multidrop control	75
[ENQ]	<n>	05H		Inquire status (Refer to command descriptions).	79
[BS]		08H	&%BS	Back space	20
[HT]		09H		Horizontal tab	20
[LF]		0AH	&%LF	Linefeed	19
[VT]		0BH	&%VT	Vertical tab	24
[FF]		0CH	&%FF	Form feed	24
[CR]		0DH	&%CR	Carriage return	19
[SO]4		0EH	&%MW	One-line double-wide	36
[SI]		0FH	&%F1	Set 17 cpi	34
[DC2]		12H	&%F3	Set 10 cpi	34
[DC4]		14H	&%MN	Cancel one-line double-wide	36
[CAN]		18H	&%RP	Clear print buffer	72
[ESC]		1BH	&%	Begin escape sequence	
[SP]2		20H		Space character	
<32> ... <255>		20H - 0FFH		Printable characters	
[ESC]	[SI]	1BH, 0FH	&%F4	Set 24 cpi	34
[ESC]	[DC1]	1BH,11H	&%VO	Open for validation	61
[ESC]	[DC3]	1BH,13H	&%VC	Close for validation	61
[ESC]	[DC4]	1BH,14H	&%VS	Select validation mode with automatic form sense	62
[ESC]	[EM] B <n>	1BH,19H,42H	&%BH <m^1>	Bar code height n = 0 Restore defaults n = 1 to 9 Number of passes (0.11 inch per pass)	54
[ESC]	[EM] C <n>	1BH,19H,43H	&%ZC <m^1><m^2>	Validation clamp delay	64
[ESC]	[EM] D <n>	1BH,19H,44H	&%ZD <m^1><m^2>	Set eject-wait pause time	65
[ESC]	[EM] M<n>	1BH,19H,4DH	&%ZM<m^1> <m^2>	Set MICR start delay	71
[ESC]	[EM] P <n>	1BH,19H,50H	&%ZP<m^1> <m^2>	Set slip top of form adjustment	66
[ESC]	[EM] S <n>	1BH,19H,53H	&%ZS <m^1><m^2>	Set slip-validation time out	64
[ESC]	[EM] U <n>	1BH,19H,55H	&%ZU<m^1> <m^2>	Set clamp-open time out	65
[ESC]	[EM] V <n>	1BH,19H,56H	&%ZV<m^1> <m^2>	Set validation time out	64

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	[EM] W<n>	1BH,19H,57H	&%ZW<m^1><m^2>	Set eject-wait time	65
[ESC]	# 0	1BH,23H,30H	&%QT	Set normal print mode (HSD is normal).	26
[ESC]	% G	1BH,25H,47H	&%MI	Begin italics	40
[ESC]	% H	1BH,25H,48H	&%CI	End italics	40
[ESC]	* <m><n^1><n^2>	1BH,2AH		Print Epson 9-pin graphics in mode <m>	48
[ESC]	! <n>	1BH,21H	&%CS <m^1><m^2> <m^3><m^3>	Select International Character Set	28
[ESC]	- <n>	1BH,2DH	&%CU {n=0} &%MU {n=1}	Underline n = 0 end n = 1 begin	38
[ESC]	0	1BH,30H	&%ST	Set 1/8 inch line space	22
[ESC]	1	1BH,31H	&%SG	Set 7/72 inch line space	23
[ESC]	2	1BH,32H		Begin variable line spacing (enable [ESC] A n)	23
[ESC]	3 <n>	1BH,33H	&%SV <m^1><m^2> <m^3>	Set fine line space n/216 inch (n = 1..255) (defines feed used by LF)	22
[ESC]	4	1BH,34H	&%ST	Set top of form	24
[ESC]	5 <n>	1BH,35H	&%CA {n=0} &%MA {n=1}	Set automatic linefeed (n = 0 end; n = 1 begin)	25
[ESC]	8	1BH,38H	&%PF	Disable paper-error sensing	58
[ESC]	9	1BH,39H	&%PO	Enable paper-error sensing	58
[ESC]	:	1BH,3AH	&%F2	Set 12 cpi	34
[ESC]	<	1BH,3CH	&%PT	Print-suppress and pass-through	73
[ESC]	? <m><n>	1BH,3FH		Reassign graphic mode	48
[ESC]	A <n>	1BH,41H		Set variable line spacing n/72 (n = 1…85) (enabled by [ESC] 2)	23
[ESC]	B <n^1><n^2> <n^3>… <n^k><0>	1BH,42H		Vertical tab set (Sets tabs at lines n^1 n^2 … n^k 0)	24
[ESC]	C <n>	1BH,43H	&%	Set form length in lines or inches	25
[ESC]	D <n^1><n^2> <n^3>… <n^k> <0>	1BH,44H		Horizontal tab set (Sets tabs at columns n^1 n^2 … n^k 0) The maximum value of n depends on the station selected.	20
[ESC]	E	1BH,45H	&%MM	Begin emphasized print (half-speed)	39
[ESC]	F	1BH,46H	&%CM	End emphasized print	39
[ESC]	G	1BH,47H	&%ME	Begin enhanced print (double-pass)	39

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	H	1BH,48H	&%CE	End enhanced print	39
[ESC]	I <n>	1BH,49H	&%QT {n=0} &%QU {n=1} &%QL {n=2} &%QS {n=3}	Select print mode n = 0 High Speed Draft n = 1 Utility n = 2 NLQ Courier n = 3 NLQ Sans Serif	26
[ESC]	J <n>	1BH,4AH	&%FM <m^1><m^2> <m^3>	Do a fine linefeed n/216 inch n = 0 no line feed n = 1...255	22
[ESC]	K <$n>^1$ <$n>^2$	1BH,4BH		Single-density graphics n1 = 0...255 n2 = 0…3 Len = n1 +256*n2	47
[ESC]	L <$n>^1$ <$n>^2$	1BH,4CH		Double-density half-speed graphics n1 = 0 ..255 n2 = 0...3 Len = n1 + 256*n2	47
[ESC]	P <n>	1BH,50H	&%RI {n=2} &%RF {n=1} &%RN {n=0}	Rotated font n = 0 normal n = 1, rotated 90°, 7 x 9 n = 2, rotated 270°, 7 x 9 n = 5, rotated 90°, 5 x 7 n = 7, rotated 270°, 5 x 7	
[ESC]	R	1BH,52H	&%HV	Reset horizontal and vertical tabs to defaults	20
[ESC]	S <n>	1BH,53H	&%SB {n=1} &%SP {n=0}	Select superscript/subscript n = 0 superscript n = 1 subscript	39
[ESC]	T	1BH,54H	&%SE	End superscript/subscript	40
[ESC]	U <n>	1BH,55H	&%GU {n=1} &%GB {n=0}	Select bidirectional/unidirectional n = 0 bidirectional n = 1 unidirectional	48
[ESC]	V <n>	1BH,56H		Set intercharacter spacing	35
[ESC]	W <n>	1BH,57H	&%FS {n=0} &%FD {n=1} &%FH {n=3}	Multiline double-wide double-high sequence n = 0 end all n = 1 begin double-wide n = 2 begin double-high n = 3 both	37
[ESC]	X <n_1><n_2>	1BH,58H		Set left and right margin n_1 = left in characters n_2 = right in characters	65
[ESC]	Y <$n>^1$ <$n>^2$	1BH,59H		Double-density full-speed graphics n1 = 0..255 n2 = 0..3 Len = n1 +256 * n2	47

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	Z <n>[1] <n>[2]	1BH,5AH		Quad-density full-speed graphics n1 = 0..255 n2 = 0..3 Len = n1 +256 * n2	47
[ESC]	[@ ...	1BH,5BH, 40H		Set print style (See command description).	37
[ESC]	[P <n>	1BH,5BH, 50H	&%F1-7	Set character pitch	35
[ESC]	[T <n>	1BH,5BH, 54H	&%CP	Set character set by code page	30
[ESC]	]	1BH,5DH	&%LR	Reverse linefeed	25
[ESC]	^<n>	1BH,5EH	&%CC	Print control code	31
[ESC]	_ <n>	1BH,5FH	&%CO {n=0} &%MO {n=1}	Overscore n = 0 end n = 1 begin	38
[ESC]	a <n>	1BH,61H	&%JR &%JC &%JL	Set justification n = 0 left n = 1 center n = 2 right	21
[ESC]	b <n> ... [ETX]	1BH,62H	&%25 {n=0} &%39 {n=1} &%12 {n=2} &%UP {n=3} &%EA {n=4}	Print bar code n = 0 Interleave 2 of 5 n = 1 Code 39 n = 2 Code 128 n = 3 UPC A n = 4 EAN-13	53
[ESC]	d <n>	1BH,64H	&%FL	Feed <n> lines at the current spacing	23
[ESC]	F	1BH,66H	&%SR	Select receipt station	56
[ESC]	g <n>	1BH,67H	&%GP {n=0} &%GS {n=1} &%GE {n=2} &%GW {n=3}	Graphic-save buffer control where <n> = 0 print buffer <n> = 1 clear and start save <n> = 2 end save <n> = 3 end save and store to nonvolatile memory <n> = 7 define and save start-up macro	51
[ESC]	i	1BH,69H	&%VF	Select front validation mode (slip mode)	62
[ESC]	j <n>	1BH,6AH	&%VS {n = 3} &%VB {n = 1} &%VR {n = 2}	Select validation mode where <n> = 1 bottom justified <n> = 2 right justified <n> = 3 both bottom and right justified	62
[ESC]	k	1BH,6BH	&%VE	Eject slip	63
[ESC]	l <n>	1BH,6CH	&%SD {n = 1} &%SS {n = 0}	Dual station operation enables journal feed in slip or receipt mode. n = 1 dual station n = 0 single station	67

[ESC]	mD	1BH,6DH, 44H	&%MD	MICR reader data request	70

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	mE	1BH,6DH, 45H	&%MP	MICR reader eject request	70
[ESC]	mI	1BH,6DH, 49H	&%MQ	MICR reader reset	68
[ESC]	mL	1BH,6DH, 4CH	&%ML	MICR reader load request	70
[ESC]	mP	1BH,6DH, 50H	none	MICR reader read request (no data return)	69
[ESC]	mR	1BH,6DH, 52H	&%MR	MICR reader read request	69
[ESC]	mS	1BH,6DH, 53H	&%MS	MICR reader status request	68
[ESC]	mT	1BH,6DH, 54H	&%MT	MICR reader transport request	70
[ESC]	p <n>	1BH,70H	&%PE <m^1><m^2>	Select paper-error mode and count	58
[ESC]	q <n>	1BH,71H	none	Buffer marker query	72
[ESC]	r <n>	1BH,72H	&%R0 {n=0} &%R1 {n=1} &%R2 {n=2} &%R3 {n=3}	Rotated print <n> = 0 end <n> = 1 rotate by 90° <n> = 2 rotate left 180° <n> = 3 rotate by 270° Note: other font and format options are available.	43
[ESC]	s <n>	1BH,73H	&%RL <m^1><m^2> <m^3>	Set rotated print line length (n = 1..128) Default 80	45
[ESC]	u <$n>^1$ <$m>^1$ <$n>^2$ <$m>^2$ ... <$n>^k$ <0>	1BH,75H		Set rotated print line spacing (nk = 0 end) Where n = line and m = dots from last line. Note: All lines not specified are set to 1 dot.	46
[ESC]	v	1BH,76H	&%FC	Cycle receipt cutter	56
[ESC]	w <n>	1BH,77H		Enable dynamic response	75
[ESC]	x <n>	1BH,78H	&%D1 {n=1} &%D2 {n=2}	Open Cash Drawer n (n = 1 or 2)	73
[ESC]	y <n>	1BH,79H	&%Y0 - 7 or &%YXnnn	Control diagnostics and extended features (See description).	74
[ESC]	Z	1BH,7AH		Release the form	63
[ESC]	~ <n>	1BH,7EH		Diagnostic commands enabled by [ESC]y<8>. See command description for <n>.	87

5.19 Control Codes Summary by Function

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
				Print/paper motion	
[BS]		08H	&%BS	Back space	20
[CR]		0DH	&%CR	Carriage return	19
				Vertical motion	
[LF]		0AH	&%LF	Linefeed	19
[VT]		0BH	&%VT	Vertical tab	24
[FF]		0CH	&%FF	Form feed	24
[ESC]	0	1BH,30H	&%ST	Set 1/8 inch line space	22
[ESC]	1	1BH,31H	&%SG	Set 7/72 inch line space	23
[ESC]	2	1BH,32H		Begin variable line spacing (enable [ESC] A n)	23
[ESC]	3 <n>	1BH,33H	&%SV <n>	Set fine line space n/216 inch (n = 1..255) (defines feed used by LF)	22
[ESC]	4	1BH,34H	&%ST	Set top of form	24
[ESC]	5 <n>	1BH,35H	&%CA {n=0} &%MA {n=1}	Set automatic linefeed n = 0 end n = 1 begin	25
[ESC]	A <n>	1BH,41H		Set variable line spacing n/72 (n = 1..85) (enabled by [ESC] 2)	23
[ESC]	B <n>^{1}<n>^{2} <n>^{3} … <n>^{k}<0>	1BH,42H		Set vertical tabs at lines n^1 n^2 ... n^k 0	24
[ESC]	C <n>	1BH,43H	&%	Set form length in lines or inches	25
[ESC]	J <n>	1BH,4AH	&%FM <m^1><m^2> <m^3>	Do a fine linefeed n/216 inch n = 0 no line feed n = 1..255	22
[ESC]	R	1BH,52H	&%HV	Reset horizontal and vertical tabs to defaults	20
[ESC]	]	1BH,5DH	&%LR	Reverse linefeed	25
[ESC]	d <n>	1BH,64H	&%FL	Feed <n> lines at the current spacing	23
				Horizontal motion	
[HT]		09H		Horizontal tab	20
[ESC]	D <n>^{1}<n>^{2} <n>^{3} … <n>^{k} <0>	1BH,44H		Horizontal tab set (Sets tabs at columns n^1 n^2 ... n^k 0) The maximum value of n depends on the station selected.	20
[ESC]	R	1BH,52H	&%HV	Reset horizontal and vertical tabs to defaults	20
[ESC]	V <n>	1BH,56H		Set intercharacter spacing	35
[ESC]	X <n_1><n_2>	1BH,58H		Set left and right margin n1 = left in characters n2 = right in characters	65

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	a <n>	1BH,61H	&%JR &%JC &%JL	Set justification n = 0 left n = 1 center n = 2 right	21
[ESC]	U <n>	1BH,55H	&%GU {n=1} &%GB {n=0}	Select bidirectional/unidirectional n = 0 bidirectional n = 1 unidirectional	48
				Character Fonts	
[ESC]	# 0	1BH,23H,30H	&%QT	Set normal print mode (HSD is normal)	26
[ESC]	E	1BH,45H	&%MM	Begin emphasized print (half-speed)	39
[ESC]	F	1BH,46H	&%CM	End emphasized print	39
[ESC]	G	1BH,47H	&%ME	Begin enhanced print (double-pass)	39
[ESC]	H	1BH,48H	&%CE	End enhanced print	39
[ESC]	I <n>	1BH,49H	&%QT {n=0} &%QU {n=1} &%QL {n=2} &%QS {n=3}	Select print mode n = 0 High Speed Draft n = 1 Utility n = 2 NLQ Courier n = 3 NLQ Sans Serif	26
[ESC]	[@ …	1BH,5BH, 40H		Set print style (See command description).	37
				International Character Sets	
[ESC]	! <n>	1BH,21H	&%CS <m^1><m^2> <m^3><m^4>	Select International Character Set	28
[ESC]	[T <n>	1BH,5BH, 54H	&%CP	Set character set by code page	30
				Character Pitch	
[DC2]		12H	&%F3	Set 10 cpi	34
[ESC]	:	1BH,3AH	&%F2	Set 12 cpi	34
[SI]		0FH	&%F1	Set 17 cpi	34
[ESC]	[SI]	1BH,0FH	&%F4	Set 24 cpi	34
[ESC]	[P <n>	1BH,5BH, 50H	&%F1-7	Set character pitch	35
				Character Attribute	
[SO]4		0EH	&%MW	One-line double-wide	36
[DC4]		14H	&%MN	Cancel one-line double-wide	36
[ESC]	% G	1BH,25H,47H	&%MI	Begin italics	40
[ESC]	% H	1BH,25H,48H	&%CI	End italics	40
[ESC]	- <n>	1BH,2DH	&%CU {n=0} &%MU {n=1}	Underline n = 0 end n = 1 begin	38

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	S <n>	1BH,53H	&%SB {n=1} &%SP {n=0}	Select superscript/subscript n = 0 superscript n = 1 subscript	39
[ESC]	T	1BH,54H	&%SE	End superscript/subscript	40
[ESC]	W <n>	1BH,57H	&%FS {n=0} &%FD {n=1} &%FH {n=3}	Multiline double-wide double-high sequence n = 0 end all n = 1 begin double-wide n = 2 begin double-high n = 3 both	37
[ESC]	_ <n>	1BH,5FH	&%CO {n=0} &%MO {n=1}	Overscore n = 0 end n = 1 begin	38
				Rotated Print	
[ESC]	P <n>	1BH,50H	&%RI {n=2} &%RF {n=1} &%RN {n=0}	Rotated font n = 0 normal n = 1 rotated 90°, 7 x 9 n = 2 rotated 270°, 7 x 9 n = 5 rotated 90°, 5 x 7 n = 7 rotated 270°, 5 x 7	27
[ESC]	r <n>	1BH,72H	&%R0 {n=0} &%R1 {n=1} &%R2 {n=2} &%R3 {n=3}	Rotated print n = 0 end n = 1 rotate by 90° n = 2 rotate left 180° n = 3 rotate by 270° Note: other font and format options are available.	43
[ESC]	s <n>	1BH,73H	&%RL <m^1><m^2><m^3>	Set rotated print line length (n = 1..128); default 80	45
[ESC]	u <$n>^1$ <$m>^1$ <$n>^2$ <$m>^2$ … <$n>^k$ <0>	1BH,75H		Set rotated print line spacing (n^k = 0 end) Where n = line and m = dots from the last line. Note: All lines not specified are set to 1 dot.	46
				Graphics	
[ESC]	* <m><$n>^1$ <$n>^2$	1BH,2AH		Print Epson 9-pin graphics in mode <m>	48
[ESC]	? <m><n>	1BH,3FH		Reassign graphic mode	48
[ESC]	K <$n>^1$ <$n>^2$	1BH,4BH		Single-density graphics n1 = 0..255 n2 = 0..3 Len = n1 +256*n2	47

[ESC]	L <n>[1] <n>[2]	1BH,4CH		Double-density half-speed graphics n1 = 0..255 n2 = 0..3 Len = n1 + 256*n2	47

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	Y <n>[1] <n>[2]	1BH,59H		Double-density full-speed graphics n1 = 0..255 n2 = 0..3 Len = n1 +256 * n2	47
[ESC]	Z <n>[1] <n>[2]	1BH,5AH		Quad-density full-speed graphics n1 = 0..255 n2 = 0..3 Len = n1 +256 * n2	47
[ESC]	g <n>	1BH,67H	&%GP {n=0} &%GS {n=1} &%GE {n=2} &%GW {n=3}	Graphic-save buffer control where <n> = 0 print buffer <n> = 1 clear and start save <n> = 2 end save <n> = 3 end save and store to nonvolatile memory <n> = 7 save a startup macro.	51
[ESC]	U <n>	1BH,55H	&%GU {n=1} &%GB {n=0}	Select bidirectional/unidirectional n = 0 bidirectional n = 1 unidirectional	48
				Bar codes	
[ESC]	b <n> ... [ETX]	1BH,62H	&%25 {n=0} &%39 {n=1} &%12 {n=2} &%UP {n=3} &%EA {n=4}	Print bar code n = 0 Interleave 2 of 5 n = 1 Code 39 n = 2 Code 128 n = 3 UPC A n = 4 EAN-13	53
[ESC]	[EM] B <n>	1BH,19H,42H	&%BH <m[1]>	Bar code height n = 0 restore defaults n = 1 to 9 number of passes (0.11 inch per pass)	54
				Station Control	
[ESC]	[DC1]	1BH,11H	&%VO	Open for validation	61
[ESC]	[DC3]	1BH,13H	&%VC	Close for validation	61
[ESC]	[DC4]	1BH,14H	&%VS	Select validation mode with automatic form sense	62
[ESC]	[EM] C <n>	1BH,19H,43H	&%ZC <m[1]><m[2]>	Validation-clamp delay	64
[ESC]	[EM] D <n>	1BH,19H,44H	&%ZD<m[1]> <m[2]>	Set eject-wait pause time	65
[ESC]	[EM] P <n>	1BH,19H,50H	&%ZP <m[1]><m[2]>	Set slip top of form adjustment	66
[ESC]	[EM] S <n>	1BH,19H,53H	&%ZS <m[1]><m[2]>	Set slip-validation time out	64
[ESC]	[EM] U <n>	1BH,19H,55H	&%ZU <m[1]><m[2]>	Set clamp-open time out	65

[ESC]	[EM] V <n>	1BH,19H,56H	&%ZV <m^1><m^2>	Set validation time out	64

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	[EM] W<n>	1BH,19H,57H	&%ZW <m^1><m^2>	Set eject-wait time	65
[ESC]	f	1BH,66H	&%SR	Select receipt station	56
[ESC]	i	1BH,69H	&%VF	Select front validation mode (slip mode)	62
[ESC]	j <n>	1BH,6AH	&%VS {n = 3} &%VB {n = 1} &%VR {n = 2}	Select validation mode where <n> = 1 bottom justified <n> = 2 right justified <n> = 3 both bottom and right justified	62
[ESC]	k	1BH,6BH	&%VE	Eject slip	63
[ESC]	l <n>	1BH,6CH	&%SD {n = 1} &%SS {n = 0}	Dual-station operation enable journal feed in slip or receipt mode n = 1 dual-station n = 0 single-station	67
[ESC]	v	1BH,76H	&%FC	Cycle receipt cutter	56
[ESC]	z	1BH,7AH		Release the form	63
				MICR option	
[SOH]	<addr>	01H		Multidrop control	75
[ESC]	mI	1BH,6DH,49H	&%MQ	MICR reader reset	68
[ESC]	mS	1BH,6DH,53H	&%MS	MICR reader status request	68
[ESC]	mR	1BH,6DH,52H	&%MR	MICR reader read request	69
[ESC]	mP	1BH,6DH,50H	none	MICR reader read request (no data return)	69
[ESC]	mD	1BH,6DH,44H	&%MD	MICR reader data request	70
[ESC]	mL	1BH,6DH,4CH	&%ML	MICR reader load request	70
[ESC]	mE	1BH,6DH,45H	&%MP	MICR reader eject request	70
[ESC]	mT	1BH,6DH,54H	&%MT	MICR reader transport request	70
[ESC]	[EM] M<n>	1BH,19H,4DH	&%ZM<m^1> <m^2>	Set MICR start delay	71
				Miscellaneous	
[ESC]	^<n>	1BH,5EH	&%CC	Print control code	31
[ENQ]	<n>	05H		Inquire status (Refer to command descriptions).	79
[CAN]		18H	&%RP	Clear print buffer	72
[ESC]	8	1BH,38H	&%PF	Disable paper-error sensing	58
[ESC]	9	1BH,39H	&%PO	Enable paper-error sensing	58
[ESC]	<	1BH,3CH	&%PT	Print-suppress and pass-through	73

[ESC]	p <n>	1BH,70H	&%PE <m^1><m^2>	Select paper-error mode and count	58

Normal ASCII	Second ASCII field	Hex Code	IPCL Equivalent code	Description	Page
[ESC]	q <n>	1BH,71H	none	Buffer marker query	72
[ESC]	w <n>	1BH,77H	none	Enable dynamic response	75
[ESC]	x <n>	1BH,78H	&%D1 {n=1} &%D2 {n=2}	Open cash drawer n (n = 1 or 2)	73
				Diagnostics	
[ESC]	y <n>	1BH,79H	&%Y0 – 7 &%Yxnnn	Control diagnostics and extended features (See descriptions on page 74).	74
[ESC]	~ <n>	1BH,7EH		Diagnostics commands enabled by [ESC]y<8> (See command description for <n>).	87

6 Operator Panel Controls

6.1 Push Buttons - Momentary switches

The RELEASE key opens and closes the validation clamp. It cycles through three modes: open, closed, and jam removal. If the RELEASE key is held for two seconds, the slip drive will be activated. Activating the slip drive is useful for removing jammed slips.

The FEED key advances the receipt and journal paper. If the FEED and RESUME keys are pressed together, the receipt and journal paper will feed in a reverse direction.

The RESUME key restarts the printer after a validation load failure has been cleared.

6.2 Indicators

There are two indicators. One is READY and the other is FORM (status). The ready indicator is tricolored: red, green, or orange. The printer can be in any of the following states:

STATE	READY Indicator	FORM Indicator
Ready (The printer is ready to receive data and print).	green	off
Printer not ready (Cover is open).	flashing green	off
Ready but waiting for a form Request slip form Request validation form Request form be removed	orange	(status) slow flash fast flash med. flash
Ready but low on receipt paper	flashing orange/green	off
Printer errors Out of paper Slip load failed Printer fault (See 6.3 Fault Indicators).	 flashing orange flashing red	 off slow flash off
Menu mode	flash orange/green/red	off
Test mode	flash red/orange	off
Printer failure	orange	off
Watchdog fault (printer resets)		

6.3 Fault Indicators

If the printer indicates “printer fault,” the error is not recoverable. The printer must be restarted and may lose information. To aid in printer troubleshooting, the RESUME key will activate an extended diagnostic indication. This will blink the status indicator a number of times. The number of blinks indicates the fault.

The errors follow.

Faults while in operation:

1 Motor move time out
2 Motor move retry fault
3 Motor move fault (moved in wrong direction)
4 Space motor locked
5 Motor homing fault
6 Motor acceleration fault
7 Printing fault
8 Fault while centering
9 Forms compensation fault

Faults during Level 0 diagnostics:

10 ROM check-sum failure
11 RAM failure
12 Configuration EEPROM failure
13 Processor test fault
14 EEPROM check-sum failure

Faults that can happen any time:

15 Firmware control fault (loss of program control)
16 Cutter option fault
17 MICR option fault
18 MKLINK fault (cutter or MICR option selected and not installed)

After the fault code is displayed, pressing the RESUME and RELEASE keys at the same time will restart the printer.

If the EEPROM check-sum fault occurs (Fault Code 14), the EEROM can be set to default by pressing the RESUME and LF keys at the same time. The printer will be functional but must be reconfigured. This procedure is only to allow reconfiguration and not to recover printer function in the field.

If the indication is “printer failure,” the printer controller is not running and is being held in reset. If printer failure occurs, the printer is not functional and should be serviced.

If the printer appears to go through a power-cycle by itself, the hardware watchdog has detected a fault. The fault is generally a hardware failure or an external interference. If the fault is hardware, the printer will continue to cycle through its diagnostics and then reset. If this happens, the printer must be serviced. If the fault is caused by external interference like electrostatic discharge, the printer will generally recover by itself. (Note: The parallel-port INIT pin causes a soft reset).

7 Product Self-tests

The Series 90PLUS printer contains several levels of self-test features. At power on, the printer always runs Level 0 diagnostics which check the printer's operation. After Level 0 diagnostics, the printer checks the keypad and enters normal operation or extended tests.

7.1 Level 0 Diagnostics

Level 0 diagnostics always run at power up. They perform the following tasks.

Test	Ready Indicator	Form Indicator
Reset	orange	off
CPU Test and ROM Test	orange	green
External RAM Test	red	green
Mechanical Tests	off	green

If any of these tests fail, the printer faults, and an error is displayed. It is possible that if the first test fails the orange/green status will remain on the display. If this occurs, the ROM or CPU is defective.

7.2 Extended Diagnostics

Extended diagnostics are entered after Level 0 diagnostics and allow one of four modes to be entered. The four modes are: self-test; hex-dump; configuration; and remote configuration. In self-test mode, the various modes of the printer can be tested. Hex-dump mode causes the printer to print the hex value of any print information sent to the printer. Configuration mode allows various configuration parameters to be adjusted, and remote configuration mode allows CFG90 to configure the printer.

7.2.1 Self-test

Pressing and holding the RESUME key at power up enters self-test mode. (As soon as the printer starts to print, the key should be released). The printer will print the software revision information and instructions for using self-test mode. The FEED key will feed paper. The RELEASE key will select a test, and the RESUME key will start the test.

There are currently eight tests in the test suite. The tests are described below.

1. The receipt test prints a sample receipt.
2. The validation test performs a sample validation.
3. The slip test performs a sample slip operation.
4. The check test (MICR calibration) prints a sample check test pattern. It tests feed control on narrow test forms. If the printer has a MICR reader, this test will perform a MICR calibration. MICR calibration requires a calibration check, which is available from Ithaca Peripherals.
5. The self-test checks a number of the printer's capabilities.
6. The mechanical test mode allows the slip drive and form compensation mechanism to be tested. The linefeed key will operate the slip drive, and the RESUME key will operate the form compensation.
7. The rolling ASCII test allows continuous print on the printer. It tests reliability and ribbon life.
8. The burn-in test is used as part of the production process to assure that the printer functions correctly and provides an initial burn-in.

8 Hex-dump Mode

Pressing and holding the RESUME and RELEASE keys at power up places the unit in hex-dump mode. This mode is used to diagnose communication problems with the printer. As information is received by the printer, the information is converted to a HEX/ASCII format and printed. No translation is made, which means no commands are interpreted. All information is converted to HEX/ASCII and printed on the receipt tape. If a carriage return is sent to the printer, it will be translated to 0D in the HEX field and "." in the ASCII field.

The format is as follows:

```
54  68  69  73  20  69  73  20        This is
61  20  74  65  73  74  0D  0A        a test..
```

There are several indications of printer and host communication problems that can be deduced from this test. If the printer is printing all 40 "@" symbols, the parity or the number of bits is wrong. If the printer is printing some Hex 40 "@" signs when it should be printing other characters, either the parity, the baud rate, or the bit length setting is wrong. If the printer prints incorrect characters (like Hex C1 instead of Hex 41 "A"), it is set for 8-bit data, and the host is set for 7-bit. In most cases, the print problem can be traced to the host and the printer not being configured in the same way.

9 Configuration Mode

9.1 Initial Power On

The initial power cycle of a Series 90PLUS diagnostic will find that the EEPROM is not valid. Staying in Level 0 diagnostics for about ten seconds will indicate this. During this time, the EEPROM is initialized, and a default configuration is loaded. The default will allow manual or remote configuration. It is unlikely to be the desired configuration.

9.2 Manual Configuration[14]

Pressing and holding the FEED and RESUME keys at power up enters manual configuration mode. (As soon as the printer starts to print, the keys should be released). The printer will print the software revision information and instructions for using manual configuration mode.

The RESUME key will select the next group.
The RELEASE key will select the next item.
The RELEASE and RESUME keys together will select the next option.
The RESUME and FEED keys together will print a list of all settings.
The FEED key will feed paper.

Once in configuration mode, the item to be changed should be selected with the RELEASE and RESUME keys. The item is then changed with the RESUME and RELEASE keys pressed together. It should be noted that in test mode, keys operate when they are released and not when they are pressed. This allows for multiple key depressions to be recognized.

When the proper configuration is selected, it should be verified by printing the complete configuration.
The save configuration option should then be changed from “no” to “yes”. The next group selected will save the configuration and enter normal operation.

9.3 Enable Remote Configuration

Remote configuration mode allows a remote host to set up, display configuration information, and test a Series 90PLUS printer. This mode is designed to be operated by the CFG90 program running on a PC.

To enable remote configuration, connect a PC through the serial or parallel port on the Series 90PLUS printer. Load the configuration program into the PC, and enter configuration mode. Power on the printer and hold the FEED and RELEASE keys down. After Level 0 diagnostics, the printer will enter CFG90 Mode. Refer to the CFG90 User’s Guide section of this manual for more information.

[14] Manual configuration may be locked by remote configuration. If this is the case, the only way to alter the configuration is by remote CFG90 configuration.

9.4 Feature Configuration

The Series 90PLUS printer has many configurable features. The following section discusses these features and the possible configurations. An operator can configure most all of the configurable features by manipulating the key panel in configuration mode. This method is termed manual configuration. The CFG90 program can set up all configurable features. This program runs on most standard PC computers. The CFG90 section of this manual describes how CFG90 operates. This section lists the configurations that can be set by CFG90.

Configuration features are grouped into six categories, each category has several features, and each feature has one or more selections. The following table lists all the categories, features, and selections. The default factory settings are indicated with an "*"[15] which may not be the same as the initial power up configuration.

		Recommendation
Emulation mode	The Series 90PLUS printer supports two basic printer emulation modes. These are normal (IBM-like) or EPOS (Epson-like).	
	Normal (IBM)	•
	EPOS	
Graphics	The default print mode for graphics can be set to bidirectional for the fastest print or unidirectional for the best print quality.	
	Bidirectional	•
	Unidirectional	
Receive buffer	The input receive buffer can be configured to various sizes. The optimal size is dependent on the application. The options are from 256 to 6144 bytes. To provide very tight control of the printer, a one-line mode is also provided where the printer goes busy after each [CR] and stays busy until the buffer is empty.	
	256	
	1024	
	2048	
	3072	
	4096	
	5120	
	6144	•
	1 line	
Print alignment	The line to line print registration of the printer is adjustable. This registration is important in graphic and rotated print and is set at the factory. However, if the printer has been serviced this value may need to be adjusted. The adjustment can be from -5 to +5. To aid in setting this adjustment, the printer will print an alignment chart along with the adjustment.	
	Adjust from 0 to 9	3

[15] The factory defaults can be altered by customer order.

		Recommendation
Impact energy	To allow the printer to print better on multipart forms, the impact energy supplied to the print head can be increased. In high impact mode, the print speed is decreased by about 15 percent. The high impact is only effective in slip and/or validation modes.	
	Normal	•
	Heavy slip	
	Heavy validation	
	Heavy slip/validation	
Bar code print speed	The graphic modes used to print bar codes can be changed. The normal print speed produces readable bar codes in all modes. The fast print speed produces less quality. However, with some types of bar codes they are still readable. This should be set based on your requirements for bar codes.	
	Normal	•
	Fast	
Form sense wait	The amount of time the printer waits after a form is sensed and before an action is taken is adjustable.	
	Adjust from 0 to 750 milliseconds	250 ms
Validation time out	The printer can be configured to return to receipt mode after a slip or validation command is issued. The validation time out is adjustable from off (waits forever) to 15 minutes. The slip and validation modes can be individually configured.	
	Off	•
	1 to 15 minutes	
Slip time out		
	Off	•
	1 to 15 minutes	
Clamp-open wait	After a slip-eject command is issued to the printer, the printer is in receipt mode; however, the form-clamp is open. If data is sent to the printer before the form is removed, the clamp will close and print on it. To help prevent this, there is a clamp-wait delay. This delay is configured from 0 to 30 seconds. The default is 2 seconds.	
	0 to 30 seconds (2 second resolution)	2 s
Eject-wait time	If a station-select command is sent to the printer after a slip-eject command and before the slip is removed, the printer will wait for the eject-wait time after the slip-eject command before starting the station-select command. When the slip is removed, the printer will wait for the eject-pause time before starting the command. If the slip is not removed before the eject-wait time, the printer will enter dejam mode.	
	0 to 30 seconds (2 second resolution)	4 s
Eject-pause time		
	0 to 750 milliseconds (50 millisecond resolution)	250 ms

		Recommendation
Cash drawer time	The amount of time the cash drawer is energized is adjustable from 25 to 250 milliseconds. This value will be dependent on the cash drawer being used; however, 150 milliseconds works with most drawers.	
	25 to 250 milliseconds (50 milliseconds resolution)	150 ms
M50 compatibility	The Model 50 printer uses several commands that are not supported by the M90PLUS printer. These commands (in some cases) have different functions in the M90PLUS printer. If the M50 compatibility commands are activated, the overlapping M90PLUS commands are deactivated.	
	Off	•
	On	
Reverse cash	The designation of the cash drawers can be reversed.	
Drawers	Normal	•
	Reversed	
Print zone	There are two print zone settings.	
	Normal 2.8 inches	•
	Narrow 2.4 inches	
Reset inhibit	The reset commands can be prevented from being acted on. If reset inhibit is set to “on,” the command will have no effect. (This does not effect the parallel-port INIT signal).	
	Off	•
	On	
Print-suppress and pass-through	There is a print-suppress feature that can be off, on, or pass (pass-through). How this feature is setup will determine the operation of the print-suppress command. If the print-suppress command is set to off, the command will be ignored. If the command is on, print-suppress will be active. If pass is selected, the command and data pass-through will be active.	
	Off	•
	Suppress	
	Pass-through	
Graphic-save		
Lock	Off	•
	On	
Print illegal		
Commands	No	•
	Yes	
Vertical Control		
Line spacing	The line spacing can be defaulted to 6 or 8 lpi	
	6 lpi	
	8 lpi	•

		Recommendation
Automatic linefeed	An automatic linefeed feature can be set as a default where all [CR]'s will have a [LF] added. If automatic linefeed is set to "on," the feature is activated.	
	Off	•
	On	
Automatic carriage return	An automatic linefeed feature can be set as a default where all [LF]'s will have a [CR] added. If the automatic carriage return is set to "on," the feature is activated.	
	Off	•
	On	
Form length	The default form length can be set to various lengths from 3 to 17 inches. This configuration affects how the [FF] command operates.	
	3 to 17 inches	11
Paper-out mode	The paper-out features of this printer can be configured in one of four ways. 1. Disabled - which prevents the printer from detecting the end of the receipt paper 2. Fault - which sets a PE fault as soon as paper low is detected 3. No Warning - which sets PE to fault after a set length of paper is fed and paper low is detected 4. Warning - which warns the operator when paper low is detected and then sets PE to fault after a set length of paper is fed.	
	Disabled	
	Fault	
	No warning (but is measured)	
	Warning	•
Receipt paper	In "no warning" or "warning" modes, the length of receipt paper that is fed after paper low is detected is measured. When a set length is reached the printer will insure a PE fault. The receipt paper setting specifies the length of receipt paper that is fed. The length can be set to 1 foot; 1-ply (about 8 feett); 2-ply (about 4 feet); or 3-ply (about 2 feet). This should be specified based on the type of paper you are going to use.	
	1 foot from warning to PE	
	1-ply	
	2-ply	
	3-ply	
Slip top adjustment	The position of the top of the form is adjustable from -8/72 to +7/72. The adjustment compensates for form variations.	
	-8/72 to +7/72 in 1/72 (default is 0)	0

		Recommendation
Print mode	The default print mode can be set to Draft, Utility, NLQ Courier, or NLQ Sans Serif. In most cases, Draft or Utility mode will be the default selections.	
	Draft	•
	Utility	
	NLQ Courier	
	NLQ Sans Serif	
Pitch	The default print pitch can be set to 8, 10, 12, 15, 17.1, 20, or 24 characters per inch (cpi).	
	8 cpi	
	10 cpi	
	12 cpi	
	15 cpi	
	17.1 cpi	•
	20 cpi	
	24 cpi	
Symbol Sets	**The Series 90PLUS printer supports 66 language sets. The setting defines only the default printer mode. Any set can be selected through software.**	
Language Sets	IBM specifies code pages differently than Epson. This is the IBM description.	
	IBM code page translation table	•
	437 – USA	
	850 – Multilingual	
	865 – Norway	
	860 – Portugal	
	863 – Canada French	
	852 – East Europe Latin II	
	1018 – ECMA-94	
	1028 – Roman-8	
	861 – Icelandic-861	
	774 – Baltic-774	
	1026 – ISO Latin 4 (8859/4)	
	1029 – ISO Latin 6 (8859/10)	
	1034 – Windows Baltic	
	1035 – Cyrillic-Latvian	
	1033 – KBL-Lithuanian	
	1012 – Turkey	
	1021 – Latin 5 (Windows Turkey)	
	857 – Turkey-857	
	1008 – Greek-437	

		Recommendation
	1009 – Greek-928	
	869 – Greek-869	
	1020 – Windows Greek	
	1011 – Greek-437 CYPRUS	
	862 – Hebrew NC (862)	
	1030 – Hebrew NC (862)	
	1031 – Hebrew OC	
	1032 – Windows Hebrew	
	1015 – ISO Latin 2	
	1019 – Windows East Europe	
	1014 – Polska Mazovia	
	895 – Kamenicky (MJK)	
	1024 – Hungarian CWI	
	1016 – Serbo Croatic I	
	1017 – Serbo Croatic II	
	1027 – Ukrainian	
	1072 – Bulgarian	
	1022 – Windows Cyrillic	
	855 – Cyrillic I – 855	
	866 – Cyrillic II – 866	
	1013 – Cyrillic II – 866	
	65 – ASCII (Unslashed 0)	
	67 – German	
	66 – British	
	69 – Swedish I	
	74 – French Canadian	
	72 – Dutch	
	76 – Swedish II	
	77 – Swedish III	
	78 – Swedish IV	
	79 – Turkish	
	80 – Swiss I	
	81 – Swiss II	
	90 – Publisher	
	68 – French	
	70 – Danish	
	71 – Norwegian	
	64 – ASCII (Slashed 0)	

		Recommendation
	73 – Italian	
	75 – Spanish	
	91 – Welsh	
EPOS mode code page	Epson specifies code pages differently than IBM. This is the Epson description.	
	0 – USA	•
	26 – Multilingual	
	27 – Norway	
	28 – Portugal	
	43 – Canada French	
	46 – East Europe Latin II – 852	
	42 – ECMA-94	
	58 – Roman-8	
	73 – Icelandic-861	
	74 – Baltic-774	
	56 – ISO Latin 4 (8859/4)	
	67 – ISO Latin 6 (8859/10)	
	68 – Windows Baltic	
	69 – Cyrillic-Latvian	
	63 – KBL-Lithuanian	
	29 – Turkey	
	51 – Latin 5 (Windows Turkey)	
	57 – Turkey-857	
	38 – Greek-437	
	39 – Greek-928	
	47 – Greek-869	
	50 – Windows Greek	
	41 – Greek-437 CYPRUS	
	60 – Hebrew NC (862)	
	61 – Hebrew OC	
	62 – Windows Hebrew	
	23 – ISO Latin 2	
	49 – Windows East Europe	
	22 – Polska Mazovia	
	55 – Kamenicky (MJK)	
	54 – Hungarian CWI	
	24 – Serbo Croatic I	
	25 – Serbo Croatic II	
	66 – Ukrainian	
	72 – Bulgarian	

	52 – Windows Cyrillic	
		Recommendation
	44 – Cyrillic I – 855	
	21 – Cyrillic II – 866	
	45 – Cyrillic II – 866	
	1 – French	
	2 – German	
	3 – British	
	4 – Danish I	
	5 – Swedish I	
	6 – Italian	
	7 – Spanish I	
	8 – Japanese	
	9 – Norwegian	
	10 – Danish II	
	11 – Spanish II	
	12 – Latin American	
	13 – French Canadian	
	14 – Dutch	
	15 – Swedish II	
	16 – Swedish III	
	17 – Swedish IV	
	18 – Turkish	
	19 – Swiss I	
	20 – Swiss II	
	64 – Publisher	
Zero character	The zero character can be configured to be unslashed or slashed in all character sets except IBM 64 and 65 which override this setting.	
	Unslashed	
	Slashed	•
Interface	**The Series 90PLUS printer always contains both serial and parallel communication links. However, only serial or parallel are active at any one time. (Some printers receive data on the parallel link and then drive other devices with the serial link) Because both links are present, the configuration for both is always available.**	
Communication link	The communication link configurations are: serial, parallel, and IEEE 1284. When a printer is assembled, it will be either serial or parallel. This setting should not be changed except from parallel to IEEE 1284.	
	Serial/parallel	
	Serial	
	Parallel	

	IEEE 1284	

		Recommendation
Parallel link options	The parallel option features define how the strobe, busy, and acknowledge signals operate. In normal mode, the printer follows the standard (Centronics) parallel-port conventions. With Options 1 and 3, the acknowledge and busy signals change at the same time. This is sometimes referred to as ack-after-busy. Options 2 and 3 force busy high on the rising edge of the strobe. This is sometimes referred to busy-while-strobe timing. In all cases, the data is latched on the rising edge of the strobe. In most cases, the normal timing mode will give the best and most universal results.	
	Normal ack-while-busy	•
	Option 1 ack-after-busy	
	Option 2 ack-while-busy	
	Option 3 ack-after-busy	
Parity	The serial mode parity can be set to none, odd, or even.	
	None	•
	Odd	
	Even	
Bit data	The serial bit format can be set to 8 or 7.	
	8-bit	•
	7-bit	
Protocol	The flow control protocol and the serial link can be set to Ready/Busy or XON/XOFF. If XON/XOFF is selected Ready/Busy also functions.	
	Ready/Busy	•
	XON/XOFF	
Baud rate	The bit rate of the printer can be set to: 19200, 9600, 4800, 2400, 1200, 600, or 300 BPS. The same bit rate is for send and receive.	
	19200 bits per second	
	9600 bits per second	•
	4800 bits per second	
	2400 bits per second	
	1200 bits per second	
	600 bits per second	
	300 bits per second	
DTR/RTS signal	The serial port DTR and/or RTS signal can be configured to provide flow control. If DTR is configured as the flow control signal, it will toggle to false when the buffer is full, RTS will not. When the cover is open, both signals will always toggle to false.	
	Not used	
	DTR flow	
	RTS flow	

	RTS and DTR flow	•

		Recommendation
CTS signal	If active, a false CTS will prevent the printer from sending any data to the host	
	Not used	•
	Active	
DSR signal	If active, a false DSR signal will prevent the printer from accepting any data.	
	Not used	•
	Active	
Multidrop	If set to an address, the multidrop feature will be activated at power up.	
	Off	•
	A device	
	B device	
	C device	
Off-line	This can be set to active (normal operation) or buffer-full only. In active mode, the printer will go off-line if the cover is open or the printer runs out of paper. When in buffer-full mode, the printer will only go off-line if a fault is detected. The buffer-full operates normally.	
	Active	•
	Buffer-full only	
Windows PNP	Microsoft Windows Plug and Play allows Windows to query the printer as to its identity. The printer supports this in parallel and serial mode. This option presets several of the link modes. Serial mode RTS flow control Parallel mode IEEE 1284	
	Off	•
	On	
Options		
Knife	This specifies than the knife option is attached.	
	Not present	
	Active	
MICR Check Reader	This specifies that the MICR reader option is attached.	
	Not present	
	Active	

		Recommendation
Check read delay	This specifies the delay from when the MICR senses a check and the drive is started. It allows time for alignment.	
	0 to 700 milliseconds in 100 millisecond steps	300 ms
Check reader retry count	This specifies how many times the MICR reader will attempt to reread a document with questionable data.	
	None	
	1, 2, or 3	2
Retry transit field errors	This specifies if the printer will attempt to reread a document if the check-sum on the transit field is not correct.	
	No	•
	Yes	
Save changes	This is set in self-configuration to force the printer to save changes. If this is not set to “yes”, any changes made to the configuration will not be saved.	
	No	
	Yes	

10 Communication Protocol and Print Buffers

10.1 Overview

The following figure illustrates the communication flow from host computer to printer and from printer to cash drawer.

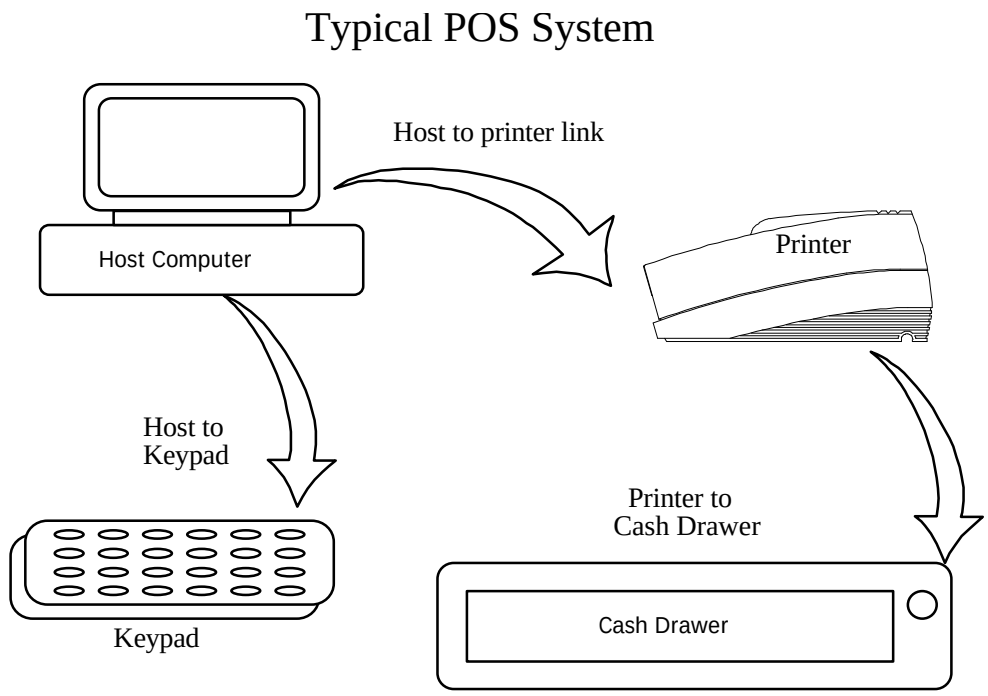


Figure 16 POS system

For the host to printer communication link, the Series 90PLUS printer supports serial or parallel communications. The serial and parallel ports both follow standards developed for the PC environment.

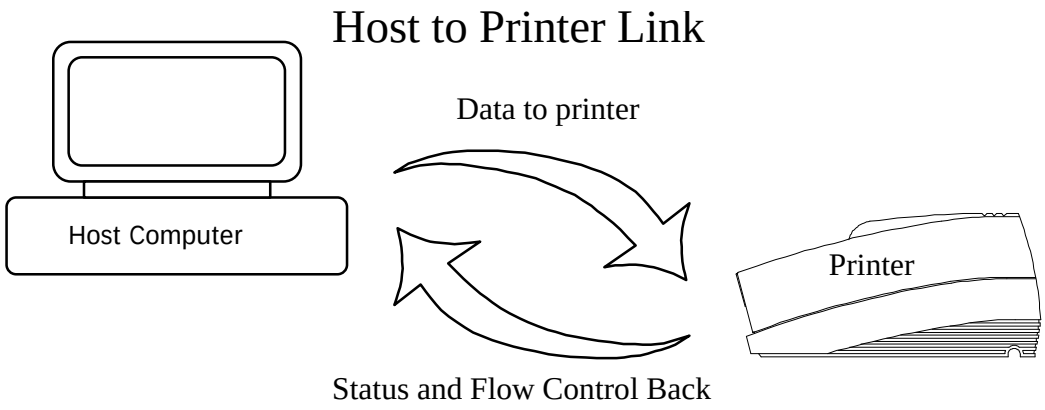


Figure 17 Host to printer link

In most cases, the host computer is capable of sending information to the printer much faster than the printer can print it. To prevent information from being lost, a flow control mechanism is provided. This mechanism is called the flow control protocol. The goal of the flow control protocol is to exchange as much information as possible as fast as possible without losing any data. The Series 90PLUS printer supports three flow control protocols, two in serial mode and one in parallel.

From the printer's point of view, there are four basic functions that are required of communications. All four are common to all three flow control protocols. There must be a communication driver, status inquire procedure, storage buffer, and print control mechanism that is using the data.

1. The communication port is either the serial-port hardware or the parallel-port hardware and the associated communication software driver.
2. A means for the host to bypass the buffer for status information is also required because the buffer offsets the printer in time from the host. (The printer is generally behind the host).
3. The storage print buffer is a software implemented, first-in first-out circular buffer. It stores information in an asynchronous fashion where information can be placed in it at any rate and retrieved from it at any rate. However, the information order is not altered. Any buffer has a finite size, and if information is put in faster than it is taken out, it will overflow. To avoid overflow, a flow control mechanism is required.
4. The print control mechanism is the remainder of the printer hardware and control software. It interprets control codes and operates the control panel, print head, and cash drawer interface.

The following figure illustrates the four basic parts of printer flow control.

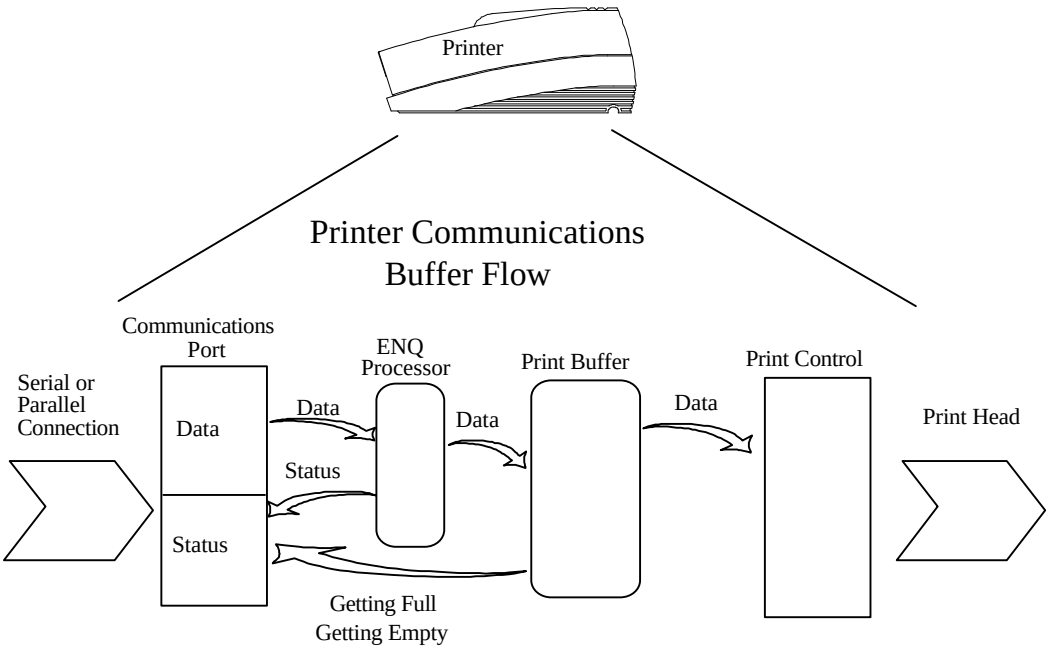


Figure 18 Printer communications

The communication port is either serial or parallel and is controlled by a software communication driver. The driver receives data and returns requested status. As information is received from the host, data is taken from the communication port hardware by the driver, preprocessed to look for status inquire commands, and placed in the buffer. When the buffer input function finds that the buffer is getting full, it notifies the communication driver to implement flow control. Flow control will attempt to stop further information from being sent from the host.

The print control software takes information from the buffer (as it needs it and can use it). When the buffer output function finds that the buffer is getting low, it notifies the communication driver that the information flow can be resumed (if it was stopped) and allows more information to be placed in the buffer.

The Series 90PLUS printer has a configurable input buffer. The printer can be configured to allow from 256 to 6144 bytes of input buffer. This means that up to 6144 characters (or control codes) can be sent to the printer before they are interpreted and printed. In effect, the host computer can get 6144 characters ahead of the printer. In all cases, the buffer will resume communications when it is half empty. For example, if the buffer is configured to be 2K, the printer will signal stop when 2048 bytes are in the buffer; resume will be signaled when 1024 bytes remain.

ENQ commands are preprocessed which means they are found in the input data stream and acted upon as they are received. This means the status returned is valid as of the time the command is received. This is termed real-time status even though ENQ commands are preprocessed and still placed in the buffer. Real-time status assures that data is not lost when the ENQ sequence is part of another command. However, this also means that the buffer may be filled by ENQ commands if the printer is waiting for some activity.

10.2 Parallel-port

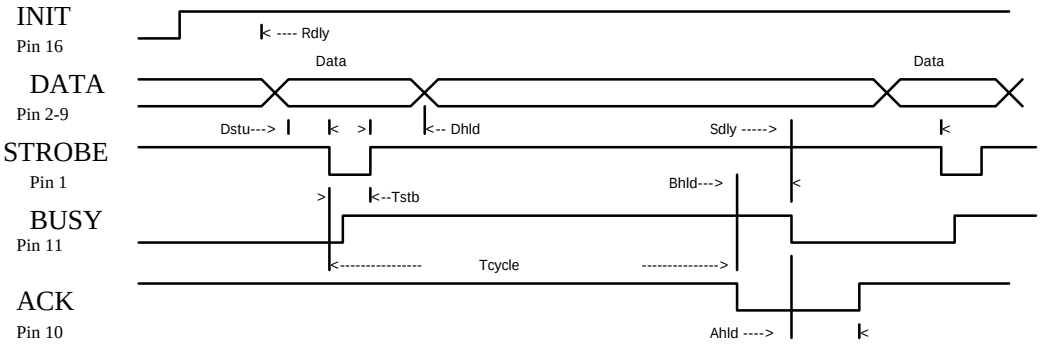
10.2.1 Parallel-port Protocol

The Series 90PLUS parallel port behaves just like any printer connected to a PC. The parallel interface accepts 8-bits of data from the host. The STROBE signal from the host is used to indicate that data is available. When the printer sees the STROBE signal and has accepted the data, it asserts a BUSY signal. The BUSY signal indicates to the host that the printer has accepted the data and is working on it. When the printer has been able to absorb the data and is ready to accept another byte, the printer asserts ACK (acknowledge), negates BUSY, and then finally negates ACK.

The host computer should meet the following parallel-port specifications and timing. In standard PC's, the strobe signal is generated by software writes to the parallel-port control port. This is typically done in the BIOS or in some parallel-port driver. As personal computers become faster, it is up to the software to assure that the STROBE signal does not get too narrow. One microsecond is about the minimum pulse width that should be sent down a cable. Shorter pulse widths (500 nanoseconds) will be accepted by the printer, however, the cable can introduce significant signal degeneration and skew.

It is very important that the data be valid before the strobe signal is asserted and remain valid until after the strobe is removed. A 500 nanosecond setup and hold time is required by the printer.

The following chart illustrates this sequence:



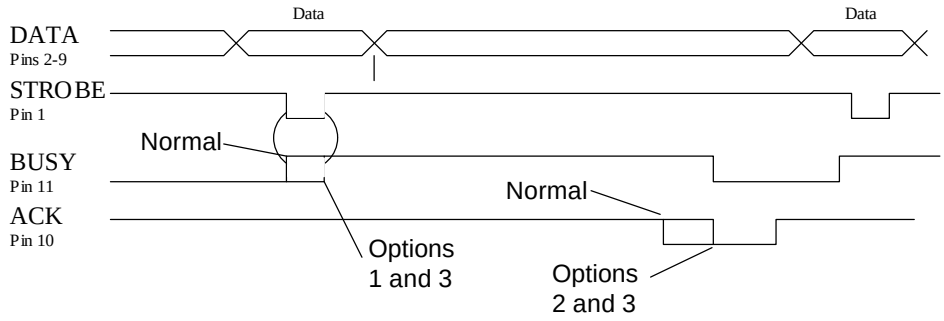
Rdly Approx. 2 Sec.	Bhld Approx. 5 uS
Dstu 500 nS (Min)	Ahld Approx. 5 uS
Dhld 500 nS (Min)	Sdly 3 uS (Min)
Tstb 1 uS (Min)	Tcycle 200 - 280 uS Typ.

Figure 19 Parallel-port data timing

To implement flow control, the BUSY signal is asserted by the printer outside the normal data transfer sequence.

The BUSY signal has several uses, but it always indicates that the printer cannot accept information. The BUSY signal may happen at any time and may not adhere to the above timing chart in all cases. It is up to the host's parallel-port driver to handle all possible BUSY states. It is important that the host driver does not hang-up if it takes some time for an ACK (acknowledge) response to a STROBE signal. Standard personal computer parallel-port hardware, implements an interrupt on the ACK signal to make this task easier.

Some systems may wish to change the details of how the Strobe, Busy, and Acknowledge signals interact. The parallel-port option features define how the Strobe, Busy, and Acknowledge signals operate. In normal mode, the printer follows the standard (Centronics) parallel-port conventions. With Options 1 and 3, the Acknowledge and Busy signals change at the same time. This is sometimes referred to as ack-after-busy. Options 2 and 3 force busy high on the rising edge of the strobe. This is sometimes referred to as busy-while-strobe timing. In all cases, the data is latched on the rising edge of the strobe. In most cases, the normal timing mode will give the best and most universal results.



10.2.2 Printer Buffer Size

The M90PLUS printer has a configurable buffer size. It can be set from 256 bytes to 6144 bytes. The configurable buffer allows an application to control how far ahead the buffer gets from the printer. The smaller the buffer, the tighter the control will be. It is up to the application developer to select the optimal buffer size.

10.2.2.1 One-line Mode

The M90PLUS printer supports a one-line mode of operation. In one-line mode, the input buffer is set to 1024 bytes; however, the printer will go busy after every [CR] received by the printer. In one-line mode, the printer will stay busy after the [CR] is received and remain busy until the previous information is printed.

There are several features that must be considered when using one-line mode. The printer only looks at [CR]'s. [LF]'s will cause the printer to print but will not set busy. If a [CR] character is received as part of another command, i.e. as part of graphic data, the printer will go busy after the [CR] is received, but will go ready after the [CR] is processed. By definition, one-line mode is slow. The printer will not allow the application to get ahead of the printer.

10.2.3 Parallel-port Inquire IEEE 1284

The Series 90PLUS printer supports the IEEE 1284 bidirectional parallel-peripheral interface standard. This standard provides for a bidirectional link on the parallel-port. The Series 90PLUS printer only supports Modes 0 and 4. This provides a nibble mode reverse-channel for printer identification and status inquire command. It is beyond the scope of this guide to describe the IEEE 1284 protocol. The complete specification is available from the

Institute of Electrical and Electronic Engineers, Inc.
345 East 47th Street
New York, NY 10017, USA

10.2.3.1 Buffer

The Series 90PLUS printer has a 256-byte buffer that contains information to be returned by the IEEE 1284 reverse link. Information is placed in this buffer in the same format as RS232 serial information is returned.

Inquire commands sent to the printer in IEEE 1284 mode will place responses to the commands in the IEEE 1284 reverse-channel buffer. This buffer is then transmitted to the host when the host requests the reverse-channel.

10.2.3.2 Mode 4

Mode 4 allows the printer to return identification information to the host system. The Series 90PLUS printer returns:

xx,yy	(length of following data, 2 bytes with msb first)
MANUFACTURER	Ithaca-Peripherals
COMMAND SET	IPCL
MODEL	90
COMMENT	Rev. x.xx
ACTIVE COMMAND SET	IPCL

When a Mode 4 request is made, the IEEE 1284 buffer is cleared before the ID is sent.

10.2.3.3 Mode 0

Mode 0 provides a reverse-channel for information from the printer.

Normal responses to ENQ commands will be placed in the IEEE 1284 reverse-channel buffer. The Mode 0 reverse-channel request will begin returning this information to the host. The host may terminate the transmission at any time. If the link is terminated between nibbles, the last nibble is retransmitted on the next request. If a complete byte is transmitted, it is deleted from the IEEE 1284 reverse-channel buffer.

There is an ENQ command that will clear the reverse-channel buffer. It will clear the buffer before placing its response in the buffer.

The IEEE 1284 buffer is limited to 256 characters. If the buffer is not emptied by reverse-channel requests, the buffer will overflow. The buffer is an FIFO buffer, and the last data placed in the buffer is lost.

No attempt should be made to send normal data to the printer while the reverse-channel is active. Any data sent to the printer in this mode will be lost and may terminate the reverse-channel link.

10.2.3.4 Time outs

The IEEE 1284 specifies time outs for various phases of the protocol. The Series 90PLUS printer treats these time outs as minimums. The printer will time out at the specified time only if it is idle during the complete phase.

10.2.3.5 Active State

The IEEE 1284 reverse-channel may be activated at any time as long as the printer is not busy with data. This means that if the printer is off-line or the cover is open, the reverse-channel may be activated. If the printer is placed back on-line while the reverse-channel is active, the printer will not exit the reverse-channel mode.

10.2.3.6 Inquire Responses

In general, ENQ commands place two-byte responses in the IEEE 1284 reverse-channel buffer. The two bytes are the same as the serial mode responses. In IEEE 1284 mode, the printer will remain busy until the ENQ command is processed. This assures responses in real time. To receive the response, the host must ask for it. It is possible for the host to make a number of requests and wait for the responses; however, the status returned will be valid at the time the request was made.

It is also possible for the dynamic-response mode to be activated and the reverse-channel mode to be opened. The reverse-channel will then change from reverse-idle to reverse-data available as the status changes. The application must be careful in dynamic-response mode that the dynamic responses are not left active when the reverse-channel is closed. If this happens, the output buffer will overflow. If there is data in the buffer when dynamic responses are activated, it will not be replaced by current status. If dynamic-response is off and a buffer-clear command is issued followed by activation of dynamic responses, the buffer will then contain fresh data. If the buffer-clear command is issued after the dynamic-response is activated, the buffer will be cleared and any unread responses will be lost.

10.2.4 Parallel-port Inquire (Non-IEEE 1284)

All ENQ commands require some type of response from the printer. The serial port is bidirectional, the non-IEEE 1284 parallel port is not. For this reason, the parallel, non-IEEE 1284 operation of ENQ commands is different from serial and parallel, IEEE 1284 modes. In serial and IEEE 1284 operation, all ENQ commands are responded to by ACK or NAK and then the command ID on the return link.

In non-IEEE 1284 parallel operation, there is no easy way to return complex information to the host. The paper-error (PE) signal is driven in response to ENQ's. If a true PE is being signaled, the ERR line will also be driven. It is, therefore, possible to distinguish between a paper-error and an ENQ response.

In parallel, non-IEEE 1284 mode, the printer will respond to the ENQ before the parallel-port sequence is complete. When the parallel port acknowledges the ID portion (the second byte) of the ENQ sequence, the PE signal will be valid. The host must, however, remember what status request was made, as the printer has no way of signaling that information. In addition, the host must not interpret the PE signal as an error but rather as a response to an ENQ.

The PE signal can be configured to respond in two ways. The first is static. The PE will remain valid until the next ENQ is issued. It may also be configured to operate dynamically which means the PE signal will follow the status of the feature being tracked. In all cases, a true paper error is dynamic. True PE status will not override any other status request. For example, if you want true PE operation, it must be selected after all other dynamic status requests.

To synchronize ENQ commands with the operation of the PE signal, the printer will remain busy after the second byte of an ENQ command until the ENQ command is processed. This typically takes about 100 microsecond.

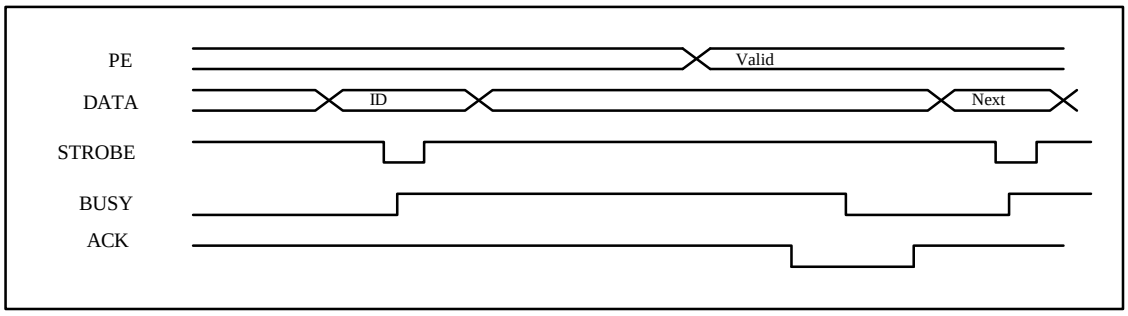


Figure 20 PE to ENQ request timing

It should be noted that ENQ commands are preprocessed (looked at and processed as they are received). This prevents the buffer from being filled with ENQ commands. However, if data pass-through is active ENQ processing must be off. If it is on, the ENQ sequences will be stripped from the pass-through data.

10.2.5 Parallel-port Plug and Play

Microsoft Windows implements Plug and Play by doing a special parallel, IEEE 1284 inquire during boot. The M90PLUS printer will respond to this inquire if IEEE 1284 is active.

If the Windows PnP configuration flag is set in the printer, IEEE 1284 will be active for all parallel-port modes. For example, PnP in parallel mode forces IEEE 1284. For PnP to work, the host must have an IEEE 1284-compatible port adapter, and the cable used to connect to the printer must support all of the interface signals.

The PnP response follows.

Device ID string:

MANUFACTURER	Ithaca-Periph.;CMD:M90CL,IPCL;CLS:PRINTER;MDL S90 PcOS;DES:Ithaca-Peripherals Series 90;REV:02.13;OPTS;$9xyz
PnP ID	LPTENUM\Ithaca-Periph.S90_PcECB3
DEVICE DESCRIPTION	Ithaca-Peripherals Series 90
DEVICE CLASS	Printer
The OPTS field is always	OPTS;$9XYZ

Where X is a model definition, X and Y are bit fields that designate the options attached to the printer.

Y			X		
Bit 0	→	Print zone	Bit 0	→	Validation present
Bit 1	→	Undefined	Bit 1	→	Knife module attached
Bit 2	→	Undefined	Bit 2	→	MICR module attached
Bit 3	→	0	Bit 3	→	0
Bits 4-5	→	1	Bits 4-5	→	1
Bits 6-7	→	0	Bits 6-7	→	0

The REV filed is the revision of the software installed in the printer.

10.2.6 Parallel-port Connector

The parallel printer interface is by a 25-pin D-shell connector. The pin-out is such that the printer will interface to a standard IBM PC parallel printer interface with a one to one cable.

The INIT\ (initialize) printer input acts as a software reset to the printer. This signal must be inactive (high) for about one second before the printer will respond to information input.

The printer asserts the PE signal whenever the journal paper is exhausted. The PE signal is also asserted in response to [ENQ] commands in parallel, non-IEEE 1284 mode.

The ERR\ signal is asserted if a head jam occurs or if the PE signal is expressed for a true paper-error. Note: the auto-FD (autofeed, Pin 14) and SLIN (select input, Pin 17) signals are not used by the Series 90PLUS printers in parallel, non-IEEE 1284 mode.

Pin 1	STROBE	Clock data to printer	Host to printer
Pins 2-9	D0 – D7	Data	Host to printer
Pin 10	ACK\	Printer accepted data	Printer to host
Pin 11	BUSY	Printer is busy	Printer to host
Pin 12	PE	Paper out/status	Printer to host
Pin 13	SLCT	Printer selected	Printer to host
Pin 14	AUTO-FD	Autofeed paper	Host to printer
Pin 15	ERR\	Printer error	Printer to host
Pin 16	INIT\	Initialize the printer	Host to printer
Pin 17	SLIN	Select printer	Host to printer
Pins 18-25	GND	Ground	

Table 13 Parallel-port pin-outs

10.2.7 Signal Levels

Voltage levels 0 V and +5 V (nominal)

Logic levels
- Logic 1
  - Driver +2.4 V to +5 V
  - Receiver +2.0 V to +5 V
- Logic 0
  - Driver 0 V to +0.4 V
  - Receiver 0 V to +0.8 V

Current requirements
- Logic 1 Source 0.25 ma at +2.4 V
- Logic 0 Sink 16 ma

Line termination
- Data and control 3.3 K ohm to +5 V
- Strobe 1.2 K ohm to +5 V

10.3 Serial Port

10.3.1 Serial Port Features

The serial port features are as follows:

Baud rates	300, 600, 1200, 2400, 4800, 9600, 19.2 K
Bit patterns	8-bit no parity; 8-bit odd; 8-bit even; 7-bit no parity; 7-bit odd; 7-bit even
Flow control	DTR and XON/XOFF

Table 14 Serial bit rates

It should be noted that the 7-bit no parity is in fact an 8-bit format. The implementation of the hardware UART in the Intel 8051 family will not implement a true 7-bit no parity format. If the host provides a true 7-bit no parity format, it must be configured with two stop bits.

The M90PLUS printer has a 64-character high-speed buffer before the main system buffer. This high-speed buffer allows the printer to operate at high serial-data rates while printing. Because no data is evaluated in this buffer, the printer will have a delayed response to inquire requests and [CR]'s in one-line operation. This has a significant effect on one-line mode operation.

10.3.2 Serial Port Pin-out

Not connected	Input	Pin 1	DCD	Data carrier detect	Not used
Used in printer	Input	Pin 2	RX	Receive data	Commands/data to print
Output to host	Output	Pin 3	TX	Transmit data	Return data
Ready and/or flow control signal to host	Output	Pin 4	DTR	Data terminal ready	Printer ready to receive data (follows buffer)
		Pin 5	GND	Signal ground	
Disable printer control from host	Input	Pin 6	DSR	Data set ready	Not used in standard printer (configurable)
Ready and/or flow control signal to host	Output	Pin 7	RTS	Request to send	Printer ready to receive data (follows buffer)
Flow control from host	Input	Pin 8	CTS	Clear to send	Not used in standard printer (configurable)
*Strapable 12 V or DTR	Output	Pin 9	SSD	Secondary data	Not used in standard printer (provides power to peripheral)

Table 15 Serial port pin-out

Because both the host and the printer are DTE's (Data Terminal Equipment), they use the same serial port pin-outs. If the cable that is used to connect the host to the printer is a pin-to-pin interconnect, it will not work. For this reason, a null modem or turn-around cable must be used to interconnect the host and the printer.

10.3.2.1 Signal Levels

The serial interface meets EIA RS232 requirements.

Logic 1	-15V to –3 V: mark = off
Logic 0	+3 V to +15 V: space = on

10.3.3 Serial Port Protocol

The serial port supports two flow-control standards, XON/XOFF and Ready/Busy (sometimes called DTR or hardware handshake.)

When Ready/Busy flow control is selected, the printer can be configured to use DTR, RTS, or both for flow control. If only DTR is selected for flow control, RTS will indicate the cover is open or the printer has faulted. The following discussions will assume the DTR is being used for flow control.

The Ready/Busy protocol generally uses the DTR signal to indicate to the host computer that the printer is not ready to accept data. The host should stop sending data to the printer as soon as possible. Because the host may not notice the DTR signal until it has transmitted several bytes of data to the printer, the printer will continue to except up to 255_{16} bytes of data after it indicates that it is not ready. Figure 21 DTR flow-control illustrates how the Ready/Busy protocol works.

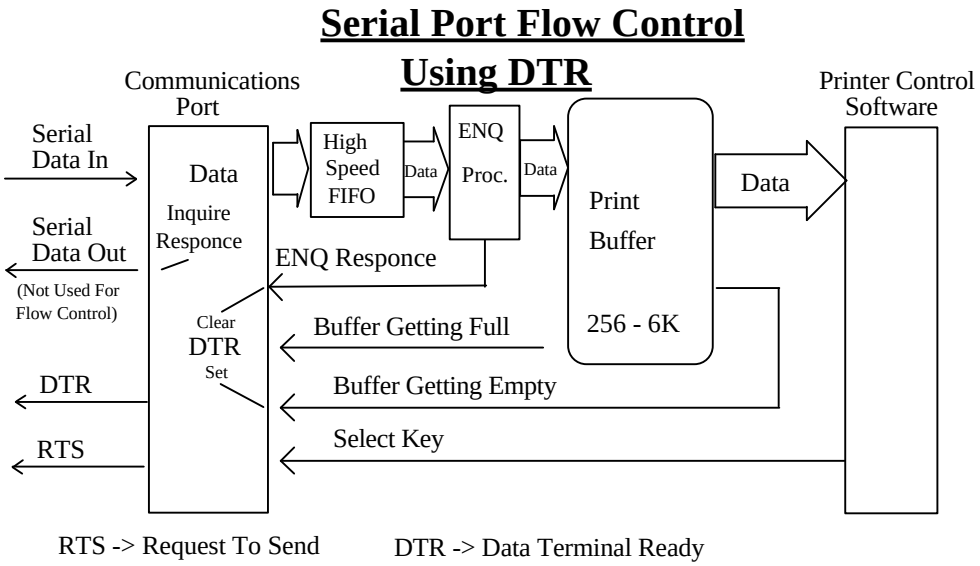


Figure 21 DTR flow-control

[16] The buffer always signals it is full before it overflows. The size of the reserve depends on the buffer size selected. It is always at least 255 bytes.

Figure 22 XON/XOFF flow-control illustrates how the XON/XOFF protocol works.

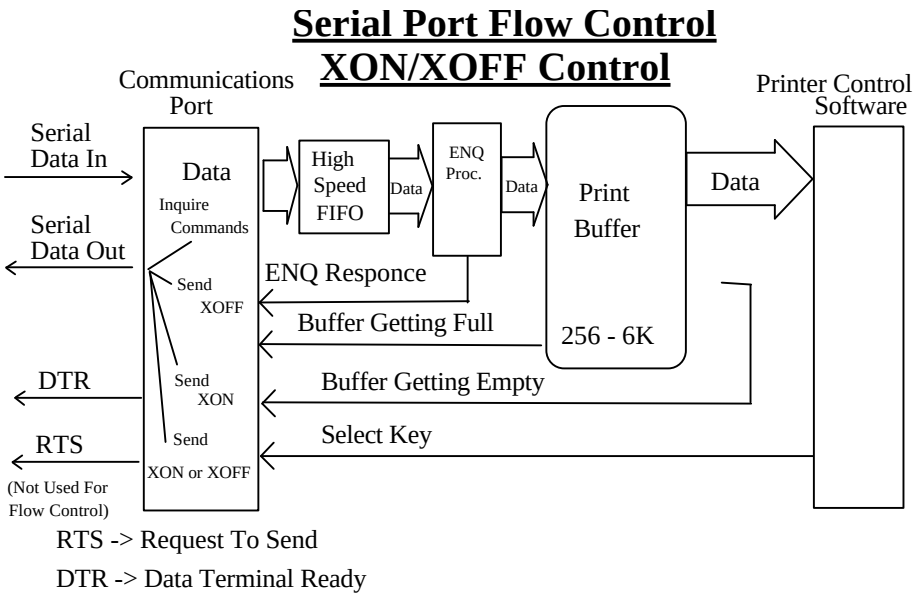


Figure 22 XON/XOFF flow-control

10.3.4 Print Buffer Flow

The following flow chart illustrates the communications driver getting data from the serial port and placing the data in the buffer using Ready/Busy or XON/XOFF flow control.

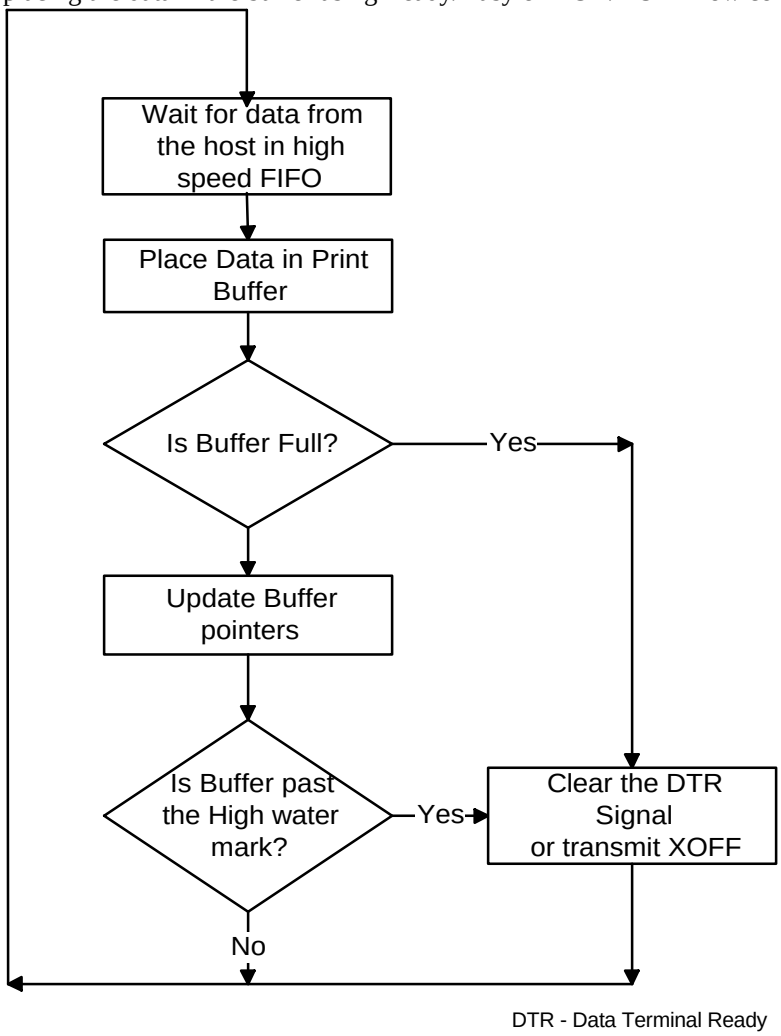

Wait for data from the host in high speed FIFO
Place Data in Print Buffer
Is Buffer Full?
Yes
Update Buffer pointers
Is Buffer past the High water mark?
Yes
Clear the DTR Signal or transmit XOFF
No
DTR - Data Terminal Ready

Figure 23 Serial buffer operation

At the top of the flow diagram, the driver is waiting for data. When data is received from the host, the printer checks to see if it is an ENQ command. If the data is an ENQ, it is responded to and placed in the buffer. If not, the data is placed in the buffer without response. The buffer is then checked to see if it is full before the internal pointer is incremented. If it is not full, the pointer is incremented in preparation for the next data byte. The buffer is checked by looking to see if it has passed a high watermark. If the buffer has, the communication driver is notified, and it resets DTR to indicate to the host that no more data should be sent.

Figure 24 illustrates how the print control software takes data from the buffer and controls flow. At the top of the chart, the print control software asks for data. If there is no data in the buffer a “no data flag” is returned. The print software must then wait for data. If there is data in the buffer, it is read, and the pointers are updated. The buffer is then checked to see how much information is left. If the buffer is below a low watermark (about 100 bytes left), the communication driver is notified, and DTR is reasserted.

If XON/XOFF flow control is being used, the flow is very similar to DTR flow except that DTR is not used and XON and XOFF control characters are transmitted back to the host on the serial link. The XON/XOFF advantage is that only three wires are required to interconnect to a printer. The disadvantage is that a serial-port receiver driver must be written for the host.

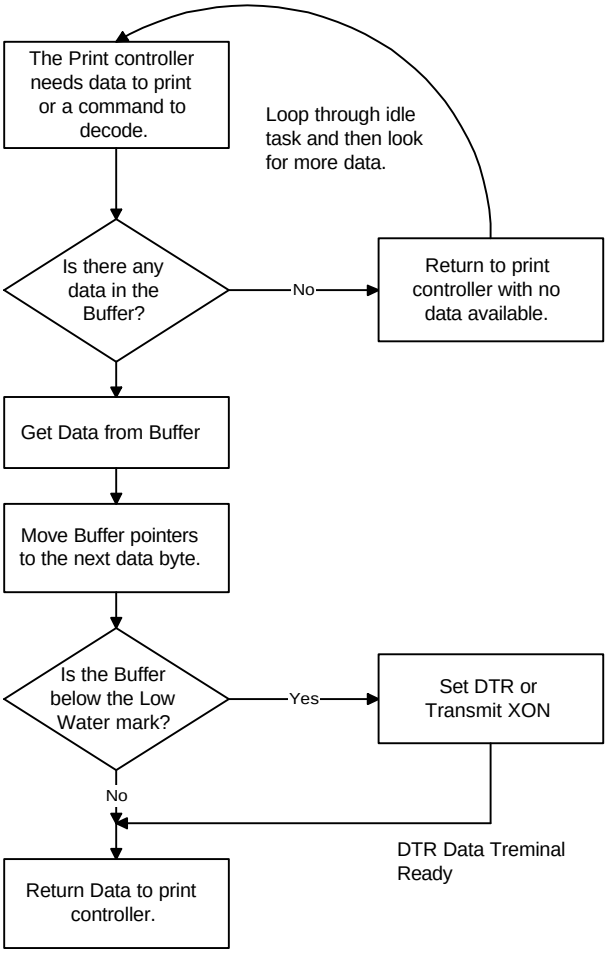

The Print controller needs data to print or a command to decode.
Loop through idle task and then look for more data.
Is there any data in the Buffer?
No
Return to print controller with no data available.
Get Data from Buffer
Move Buffer pointers to the next data byte.
Is the Buffer below the Low Water mark?
Yes
Set DTR or Transmit XON
No
DTR Data Treminal Ready
Return Data to print controller.

Figure 24 Print controller using data

The print controller is always looking for data when the printer is on-line and not printing. It continuously asks the buffer if it has any data. If there is no data in the buffer, it does housekeeping chores like keyboard scanning. If there is data, it processes it. The flow control is done when the data is taken from the buffer and the amount of data in the buffer is less than a prescribed amount. This low watermark is set

based on the expected environment. The Series 90PLUS printer sets this at 200 characters. This gives the host application time to get more data to the printer before the printer uses up what it has.

When XON/XOFF protocol is implemented, it is possible for the host to miss an XON or an XOFF. To prevent this from causing a communication lockup, the printer will send an XOFF for every character received after the high watermark is reached.

Whenever the printer detects that the serial data link is inactive, it sends out an XON. This results in an XON being sent out about every two seconds.

When the printer is selected or deselected (with the SELECT key), an XON or XOFF will also be sent. This happens even if the internal data buffer is past the high watermark[17]. This is done to allow the host to know that the SELECT key has been pressed. If the buffer is full and an XON is sent the next character by the host, an XOFF will be sent. The data that was sent by the host will not be lost unless the 255-character pad buffer is used up.

10.3.5 Printer Buffer Size

The M90PLUS printer has a configurable buffer size which allows an application to control how far ahead of the printer it can get before being asked to wait. The buffer size can be set from 256 bytes to 6144 bytes (This does not include the 64-character high-speed buffer). The smaller the buffer, the tighter the control will be. It is up to the application developer to select the optimal buffer size.

10.3.5.1 One-line Mode

The M90PLUS printer supports a one-line mode of operation. In one-line mode, the input buffer is set to 1024 bytes; however, the printer will go busy after every [CR] is received. The printer will stay busy after the [CR] is received and remain busy until the previous information is printed. This mode is not recommended for serial operation unless the application looks for the line-terminator handshake. There are several features that must be considered when using this mode.

1. The printer only looks at [CR]'s. [LF]'s will cause the printer to print but will not set busy.
2. If a [CR] character is received as part of another command (i.e. as part of graphic data), the printer will go busy after the [CR] is received, but will go ready after the [CR] is processed.
3. By definition, one-line mode is slow. The printer will not allow the application to get ahead of the printer.
4. In serial mode, one-line mode is difficult to control. Because of the 64-character high-speed FIFO, the printer will not go busy immediately after the [CR] is sent. It may take up to 25 milliseconds for the printer to process the [CR]. In this time, it is possible for the application to send up to 48 bytes of data to the printer. When the [CR] is found in the input stream, the busy status will be set. If the application continues to send information, the input buffer will be overrun as it only has 16 bytes left. In addition, the application will not truly be in one-line operation. The application must wait for at least 100 milliseconds after a [CR] before looking for busy or trying to send more data.
5. In XON/XOFF mode, the printer is heavily burdened by the task of transmitting XOFF characters while printing and receiving data. The application should be written to look for the XOFF after every [CR]. The M90PLUS printer will lose data if too many characters follow the XOFF.

[17]If the host sends more information, it will be responded to by an XOFF. If the printer cover is opened and closed in this mode too many times, it is possible for the buffer to overflow.

10.3.6 Serial Mode Plug and Play

Microsoft has defined a Plug and Play protocol to identify devices on serial links. This enumeration process is designed to find and automatically configure a device driver for the printer. It is done by toggling the control lines in a specific sequence that is recognized by the printer. The peripheral then responds such that Windows can identify the device.

To allow the printer to look for and respond to this sequence, PnP must be enabled. When enabled in serial mode, the flow control is forced to RTS with DTR static. The off-line flag can also be set.

10.3.6.1 Using DSR

Windows uses the host's DSR line (the printer's DTR line) on the serial port to determine whether a device is attached to the port. When Windows is booted, the system sets the host's DTR and RTS to 0 and waits approximately 200 milliseconds. It then sets DTR to 1 and waits another 200 milliseconds. At the end of this time, the system checks to see whether the DSR line is high, indicating that a serial device is attached to the serial port. The system responds by setting RTS high and waits to receive the device identification string.

In some devices, such as a serial mouse, the DSR line can be held high by tying it directly to the DTR line. When the mouse is connected to the serial port on the personal computer, the power supplied through the DTR line also raises DSR high.

For Plug and Play compatibility, DSR must stay high as long as the device is attached to the serial port. This is why RTS flow control is used at the printer.

10.3.6.2 Serial Device Identification

The serial device must report its identification to the system using an identification string at 1200 baud. The identification string consists of 18 fields that identify the device, the class of the device, and other compatible devices. Only five of the fields are required by all serial devices; all others are optional. The identification string used by the M90PLUS printer is as follows:

028H	Start of ASCII response
0,1	PnP Rev
'IPR0210'	Unique ID (IPR plus revision level)
\PRINTER	Printer
\S90 PcOS	Model
xxH	Check-sum
029H	End PnP

Note: The model field may be altered to generate PnP id's other than "S90 PcOS" by special order.

When the identification is complete, the printer returns to the baud rate specified in the configuration.

10.3.7 Serial-port Inquire

The serial-port inquire is more straightforward than parallel mode. The serial ACK or NAK responses follow a uniform format, the ACK or NAK is always followed by the command ID that requested it. This makes the design of the host application easier because the response can be identified and always follows the same format.

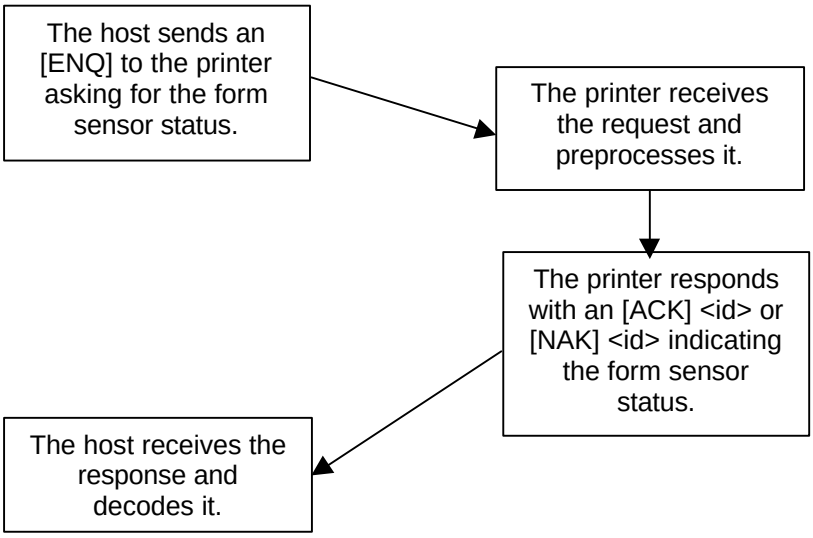

The host sends an [ENQ] to the printer asking for the form sensor status.
The printer receives the request and preprocesses it.
The printer responds with an [ACK] <id> or [NAK] <id> indicating the form sensor status.
The host receives the response and decodes it.

Figure 25 Inquire flow

The host sends an [ENQ]<id> (form-sensor status) request to the printer. The printer responds with an [ACK]<id> indicating that the request was <id>, and the status is true.

ENQ commands effect the printer's performance. The priority of communications in the printer is very high. ENQ commands take processing away from the print tasks. It is possible to ask for so much status that the printer slows down.

In serial mode, it is very important that the response to an ENQ be received by the host before another command is issued. When an ENQ is received by the printer, it is buffered in a high-speed processing queue. When the printer has time, it empties the queue and processes the ENQ's. The printer will respond to the command as soon as the second byte of the command is taken from the high-speed buffer. If the host is looking for a form to be inserted, it should not send status requests as fast as it can. The host will get a response to all of them, and if the host did not wait for a response to each, there would be unnecessary responses.

In IEEE 1284 mode, inquiry responses are placed in an IEEE 1284 transmit queue. When the IEEE 1284 reverse-channel is open, the responses are returned to the host. It is important that after each request the reverse-channel be opened. Inquire responses will remain in the queue until read. If the [ENQ]<9> command is sent to the printer, the IEEE 1284 buffer will be cleared, and only the response to the [ENQ]<9> will remain.

10.4 Remote Printer Reset

10.4.1 Reset in Serial Mode

It is possible to generate a software printer reset in serial mode. The [ENQ]<10> command will request that the printer reset. (This is not a hardware reset). It will, however, completely initialize the hardware and software but will not recover from a loss of software control.

Note: If the printer mode was changed by the [ESC]y<2> or <3> command, a soft reset will not return to the power on default.

The command flow is as follows.

1. The [ENQ]<10> will be acknowledged.
2. During cleanup and initialization, the printer will be placed off-line.
3. Before the printer initializes, it will try to clean up its input buffer and other internal processes.
    a. If there is information in the print buffer, it will be printed before the printer resets.
    b. If during cleanup the printer is in or enters an error state (like slip-load failure), the error and input buffer will be cleared, and the printer will initialize.
    c. If during cleanup, the printer is in or enters a waiting for operator action (like slip-request mode), the operator wait state and input buffer will be cleared, and the printer will initialize.
    d. If the cover is open and there is data that can be printed, the printer will wait for the cover to be closed, print the data, and then initialize.
    e. If the printer is idle, it will initialize.
4. The printer's software will be reinitialized. Most of the initial default configuration information will be reloaded; however, several configurations will not be loaded.
    a. The top of form position will not be changed.
    b. The mode (IBM/EPOS) will not be reset. Note: if the printer is in EPOS mode but was configured for IBM with a font pitch that is not a normal EPOS font, the printer will use the IBM font but stay in EPOS mode.
5. The power-cycled flag will be set.
6. The print head will be homed and recalibrated.
7. Because the reset command can clear an error state, it is possible for a form to be in the printer after initialization. If a form is detected, the printer will initialize with the form unclamped. The operator should remove it before any data is sent to the printer. The default mode for the printer is receipt mode. If data is sent to the printer without doing a station-select, the printer will close the clamp and start to print without generating an error. Receipt mode should not be assumed after reset.
8. The printer will then go back on-line.

10.4.2 Reset in Parallel Mode

In parallel mode, driving the INIT signal on the parallel port for 100 milliseconds will generate a software reset. It takes about two seconds for the printer to recover from a reset. The [ENQ] <10> command will have the same effect, but it will not be acknowledged.

10.5 Miscellaneous Communication Features

10.5.1 Power-cycle Recovery

There are times when the host needs to know if the printer was power-cycled. An example would be changing the receipt tape. It is not necessary to turn the printer off to change the receipt. However, if the operator does, any information sent to the printer before the power cycle will be lost.

The Series 90PLUS printer has a flag that is set after a reset. The flag stays set until the host requests a reset. The [ENQ]<11> command reads the flag. If the command returns power-cycled status, the power has been reset or power-cycled since the last request. All unprinted information has been lost.

If the print operation is critical, it is a good idea to check this flag before and after all transactions. An alternate approach is to check the flag after every off-line to on-line transition.

Note: If the printer mode was changed by the [ESC]y<2> or <3> command, a power-cycle reset will return to the power-on default.

10.5.2 Data Pass-through

The M90PLUS printer supports data pass-through (sometimes referred to as display pass-through). This mode is activated by the print-suppress command with the pass-through bit set. In this mode, the printer can be requested to transmit any data that it receives (pass-through). Here, the printer's inquire commands are active but of little use. Typically, the printer's transmit data is connected to the next device in line. Inquire commands have no data path back to the host. If pass-through is to be used, it is a good idea to deactivate the inquire commands. (Use [ESC]y<6> to do this).

Before pass-through data can be used, it must be activated in the configuration menu, which is the third selection in the print-suppress/pass option.

All data after, but not including, the print-suppress command is pass-through. When deactivated, the print-suppress command is again not pass-through. During pass-through the multidrop commands are active (if configured).

If a multidrop control command is found in the pass-through data, it will not be passed on, and it will be acted upon. If the printer is deselected during pass-through, the printer will stop passing on the data. When the printer is readdressed, data pass-through will be active.

10.5.3 Multidrop Configuration

The M90PLUS printer supports a multidrop configuration where up to three printers can be connected in parallel. Each printer has a different address "A", "B", or "C". The printer will not accept any print information unless it is addressed. Multidrop configuration is only available in serial mode as parallel printers cannot be connected together.

10.5.4 Off-line Active

There is a configuration flag that prevents the printer from going off-line (in most cases). Off-line mode allows the application to query the printer for status rather than assume a status from the control signals. The feature allows the host application to query the printer at all times except when there is no power; the input buffer is full; or there is a hard failure. For example, if the printer's cover is opened, the printer will stop printing but will still accept data and inquire commands. The inquire cover status command would then return cover open.

The only hard failures are no power or a printer fault. If the printer is off-line, then either the input buffer is full, or there is a hard fault. The host application should not allow the input buffer to fill.

10.6 Programmer's Notes

When the serial port is being used, it is very important that the output lines from the printer not be shorted or back driven. If the signals are not to be used, they should be left open.

Pins 3, 4, and 7 are outputs from the printer. If any one of these signals is grounded or back driven, the other two outputs will be degraded.

If the printer is to be configured by the host with remote configuration, a good time to configure the printer is during system setup or system software update.

The printer should be power-cycled after configuration to assure that the new configuration takes effect.

In serial mode, one-line mode should be avoided, particularly in XON/XOFF mode. The high-speed FIFO input buffer makes one-line mode difficult to process.

If the MICR option is selected, the printer must wait for the read amplifiers in the MICR module to stabilize. The printer will appear operational during this time and will accept data. The printer will not, however, process any data until the MICR reader is ready. This can take up to 20 seconds depending on the temperature.

If the MICR reader or knife module fails at any time, the configuration can be changed to deactivate the option. This will allow the printer to be used without the option until the printer can be repaired.

The M90PLUS printer is equipped with fault detection circuits. These circuits prevent the printer from destroying itself if the software or hardware fails. (This eliminates the need for an operator accessible fuse. The printer should never need to have the fuse replaced unless the power supply has a catastrophic failure). The detection circuit is termed "watchdog monitor". These circuits monitor the print head, carriage motor, slip-paper drive, receipt-paper drive, and the total power consumption. If the watchdog monitor detects a fault, it requests the power supply to shutdown. After the supply shutdown, the watchdog monitor will wait for about 500 milliseconds and restart. The effect is to completely reset the printer. If the fault still exists, the power supply will shutdown again. An example of a problem that would be detected by the watchdog monitor would be if the carriage motor was on but no head movement was detected. This of course should never happen.

The M90PLUS printer is not intended to be a graphic printer. The watchdog monitor will not allow heavy black-printing on a single print pass. (It is sensed as too much power usage). To allow the printer to print graphics, the printer detects heavy graphic print before it is printed and switches to a low-power two-pass mode. This slows the print time but allows almost any graphic to be printed.

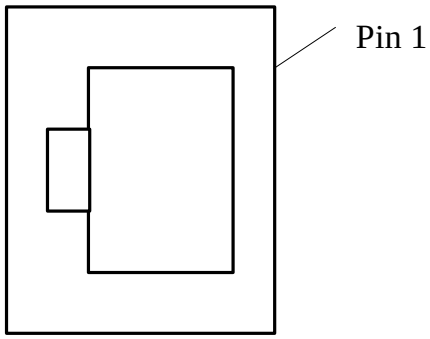
11 Cash Drawer Interface

11.1 Interface Description

The M90PLUS printer supports dual cash drawers with status. The driver in the printer is capable of supplying 24 VDC at up to 1.0 amp for 250 milliseconds. The M90PLUS printer defines cash drawer closed as switch open. If the drawer is disconnected, it will be viewed by the printer as closed. Since the printer does not act on the cash drawer status, the application can interpret cash drawer status any way it wants.

11.2 Interface Connectors

There are two cash drawer connectors. One is configured as Cash Drawer 1, the other as Cash Drawer 2. The pin-out is as follows.



Function	Drawer 1	Drawer 2
Drawer drive +	Pin 4	Pin 4
Drawer drive -	Pin 5	Pin 1
Status signal	Pin 2	Pin 2
Status ground	Pin 3	Pin 3
Frame ground	Pin 6	Pin 6
No connect	Pin 1	Pin 5

Table 16 Ithaca cash drawer connector

Note: Cash Drawer 2 can be factory configured to be the same as Cash Drawer 1. In addition, the software definition of Drawers 1 and 2 can be reversed with a menu selection.

To allow the M90PLUS printer to use Epson cash drawers in a TM375 configuration, the pin-out of the cash drawers can be changed as follows.

Function	Drawer 1	Drawer 2
Drawer drive +	Pin 4	Pin 4
Drawer drive -	Pin 2	Pin 5
No connect	Pin 5	Pin 2
Status signal	Pin 3	Pin 3
Status ground	Pin 6	Pin 6
Frame ground	Pin 1	Pin 1

Table 17 M90PLUS/M150 Epson cash drawer connector

Note: This is a factory configuration and is not configurable in the field. There is also a high-current output option.

12 Printing Graphics

The Series 90PLUS printer has bit-image graphic capability and a full PC-compatible graphic character set. The bit image format is similar to that used on other PC printers. There are three modes of operation: single-density; half-speed double-density; and full-speed double-density.

Single-density is the fastest mode. It makes a single unidirectional 60 dpi print pass. The full-speed double-density mode makes two passes with a half-dot offset. This mode is half the speed of single-density print but will print at 120 dpi. Half-speed double-density mode is half the speed of full-speed double-density; however, the print quality is enhanced.

12.1 Character Graphics

Character graphics is the term for joining individual characters together to produce a mosaic of characters that form a graphic image. The simplest method uses an * (or any other character) to form an image. For example, IPI might be formed as follows.

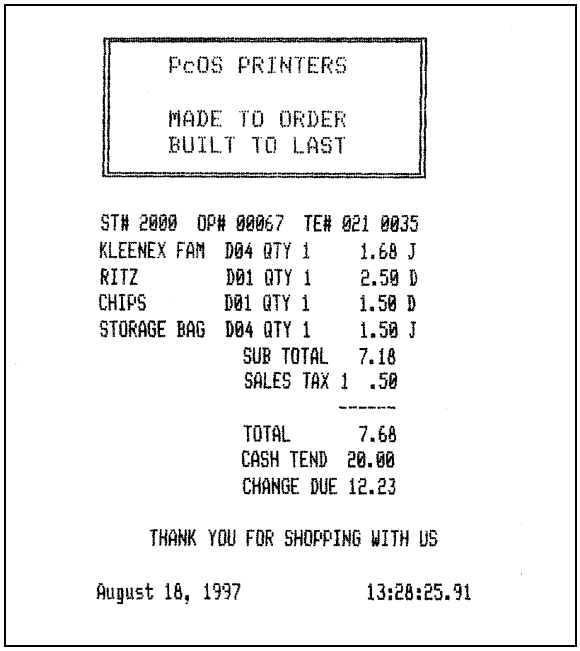
```
*** **** ***
 *   *  *  *
 *   ***   *
 *   *     *
*** *    ***
```

The extended character set of the printer supports line-graphic characters that can be combined to form windows and other shapes. For the shapes to join from line to line, the spacing must be set properly.

All characters are in a nine-dot-high character cell. The dots are 1/60 of an inch apart. Therefore, the line spacing should be 10/60 or 1/6 inch. The set fine line-space command can be used to set this line spacing. If possible, the spacing should be reduced slightly to overlap the rows. This prevents any white spacing from appearing between the lines. The following example illustrates the use of extended character graphics.

```
[ESC]U<1>           Select unidirectional print for better alignment.
[ESC]:              Select 12 cpi.
[ESC]3<34>          Set line spacing for 0.157 inch. (This is slightly smaller than 1/6 inch).
     <201>          Send the line-graphic characters to the printer.
<205><205><205><205><205><205><205><205><205>
<205><205><205><205><205><205><205><205><205>
<205><205><205><205>
<187>[CR][LF]
<186>    PcOS PRINTERS      <186>[CR][LF]
<186>                       <186>[CR][LF]
<186>    MADE TO ORDER      <186>[CR][LF]
<186>    BUILT TO LAST      <186>[CR][LF]
<200>
<205><205><205><205><205><205><205><205><205>
<205><205><205><205><205><205><205><205><205>
<205><205><205><205>
<188>[CR][LF]       This finishes the line graphics.
[ESC]U<0>           Reenable bidirectional printing.
[ESC]0              Set standard 1/8 inch line spacing.
[SI]                Set 17 cpi.
[CR][LF]            Finish the form.
```

```
ST# 2000  OP# 00067  TE# 021 0035[CR][LF]
KLEENEX FAM  D04 QTY 1     1.68 J[CR][LF]
RITZ         D01 QTY 1     2.50 D[CR][LF]
CHIPS        D01 QTY 1     1.50 D[CR][LF]
STORAGE BAG  D04 QTY 1     1.50 J[CR][LF]
               SUB TOTAL    7.18[CR][LF]
               SALES TAX 1   .50[CR][LF]
                           ------[CR][LF]
               TOTAL        7.68[CR][LF]
               CASH TEND   20.00[CR][LF]
               CHANGE DUE  12.23[CR][LF]
[CR][LF]
[ESC]a<1>
THANK YOU FOR SHOPPING WITH US[CR][LF]
[ESC]a<0>
[CR][LF]
{DATE:0}            {TIME:0}[CR][LF]
```


PcOS PRINTERS
MADE TO ORDER
BUILT TO LAST
ST# 2000 OP# 00067 TE# 021 0035
KLEENEX FAM D04 QTY 1 1.68 J
RITZ D01 QTY 1 2.50 D
CHIPS D01 QTY 1 1.50 D
STORAGE BAG D04 QTY 1 1.50 J
SUB TOTAL 7.18
SALES TAX 1 .50
TOTAL 7.68
CASH TEND 20.00
CHANGE DUE 12.23
THANK YOU FOR SHOPPING WITH US
August 18, 1997 13:20:25.91

When printing line graphics the data path to the printer must be 8-bits. Seven-bit serial protocols will not access the extended characters.

The extended characters require that the form be reverse fed. This means that printing line graphics on the receipt may be less than acceptable.

12.2 APA Graphics

The printer is capable of APA graphics[18]. Generating a graphic image by hand is time consuming and tedious. It is possible to use a graphic package to create a graphic image. The following procedure will help with the setup.

1. Generate the graphic image in the program of your choice.
2. Make sure the paper size you pick fits the printer station you intend to use. If the paper size cannot be set, print a portion of the page.
3. Print the graphic to a file using a generic IBM-graphic 9-pin driver. The standard IBM resolutions are: 240 x 216 dpi, 120 x 72 dpi, and 60 x 72 dpi. The Series 90PLUS printer supports all three resolutions. For good resolution with reasonable speed, use 120 x 72 dpi.
4. Print the graphic image to a file.
5. Edit the resulting file to remove any unwanted form control, and insert the Series 90PLUS form control.
6. Make the resulting file available to your application, so it will be sent to the printer when required.

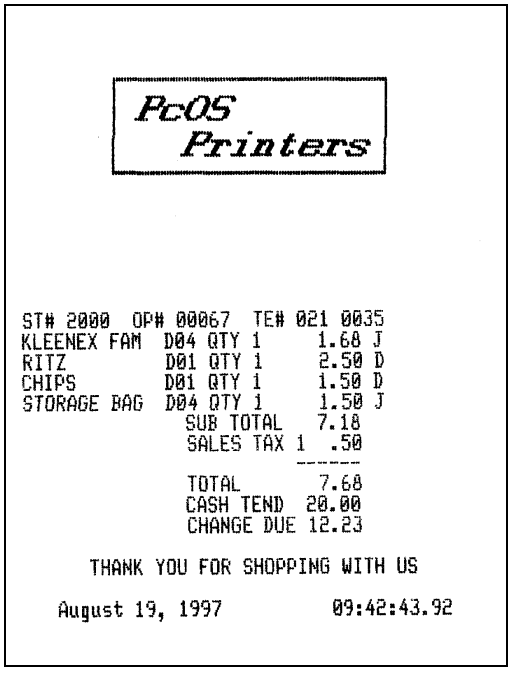

PcOS
Printers
ST# 2000 OP# 00067 TE# 021 0035
KLEENEX FAM D04 QTY 1 1.68 J
RITZ D01 QTY 1 2.50 D
CHIPS D01 QTY 1 1.50 D
STORAGE BAG D04 QTY 1 1.50 J
SUB TOTAL 7.18
SALES TAX 1 .50
TOTAL 7.68
CASH TEND 20.00
CHANGE DUE 12.23
THANK YOU FOR SHOPPING WITH US
August 19, 1997 09:42:43.92

Figure 26 Receipt with APA graphics

As with all graphics, the data path to the printer must be 8-bits. Seven-bit protocols will not work.

The quad-density graphic resolution will give the best rendition of your graphic image; however, this mode is slow and prints very dark. The printer is set up to provide the best performance in normal operation. For this reason, quad-density graphics should be used on a limited basis.

The APA graphic example in Figure 26 was done with double-density graphics. The graphic driver used made an approximation of the graphic image.

[18]APA graphics – all-points-addressable graphics

The first part of the graphic file is listed here in hex format. This is a hex dump of the first 512 bytes of the graphic file printed on the above receipt.

```
0100  1B 43 00 0B 0D 0C 46 1B-48 1B 49 01 1B 54 1B 55   .C....F.H.I..T.U
0110  00 1B 55 00 1B 46 1B 49-01 1B 66 0D 34 00 8B 0D   ..U..F.I..f.4...
0120  1B 55 01 1B 59 60 01 00-00 00 00 00 00 00 00 00   .U..Y`..........
0130  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0140  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0150  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0160  00 00 00 00 00 00 03 01-02 01 02 01 02 01 02 01   ................
0170  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
0180  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
0190  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01A0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01B0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01C0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01D0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01E0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
01F0  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
0200  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
0210  02 01 02 01 02 01 02 01-02 01 02 01 02 01 02 01   ................
0220  02 01 02 01 02 01 02 01-02 01 02 01 02 03 00 00   ................
0230  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0240  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0250  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0260  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0270  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
0280  00 00 00 00 00 00 00 1B-55 00 1B 4A 18 0D 1B 55   ........U..J...U
0290  01 1B 59 60 01 00 00 00-00 00 00 00 00 00 00 00   ..Y`............
02A0  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
02B0  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
02C0  00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00   ................
02D0  00 00 00 00 FF FF 00 00-00 00 00 00 00 00 00 00   ................
02E0  00 00 00 00 00 00 00 00-00 00 00 00 02 01 02 01   ................
02F0  02 00 02 00 02 00 02 01-02 01 00 00 00 00 00 00   ................
```

Appendix A
Language Tables

Code Page	Country Code/ Language Set	Decimal <n_1> <n_2>	Hex <n_1> <n_2>	ASCII <n_1> <n_2><n_3>	Epson ID
64	USA (Slashed 0)	0,64	0H,040H	0,0,6,4	NA
65	USA (Unslashed 0)	0,65	0H,041H	0,0,6,5	NA
66	British	0,66	0H,042H	0,0,6,6	3
67	German	0,67	0H,043H	0,0,6,7	2
68	French	0,68	0H,044H	0,0,6,8	NA
69	Swedish I	0,69	0H,045H	0,0,6,9	5
70	Danish I	0,70	0H,046H	0,0,7,0	NA
71	Norwegian	0,71	0H,047H	0,0,7,1	NA
72	Dutch	0,72	0H,048H	0,0,7,2	14
73	Italian	0,73	0H,049H	0,0,7,3	NA
74	French Canadian	0,74	0H,04AH	0,0,7,4	13
75	Spanish I	0,75	0H,04BH	0,0,7,5	NA
76	Swedish II	0,76	0H,04CH	0,0,7,6	15
77	Swedish III	0,77	0H,04DH	0,0,7,7	16
78	Swedish IV	0,78	0H,04EH	0,0,7,8	17
79	Turkish	0,79	0H,04FH	0,0,7,9	18
80	Swiss I	0,80	0H,050H	0,0,8,0	19
81	Swiss II	0,81	0H,051H	0,0,8,1	20
90	Publisher	0,90	0H,05AH	0,0,9,0	64
91	Welsh	0,91	0H,05BH	0,0,9,1	NA
437	USA	1,181	1H,0B5H	0,4,3,7	0
774	Baltic	3,6	3H,006H	0,7,7,4	74
850	Multilingual	3,82	3H,052H	0,8,5,0	26
852	East European Latin II	3,84	3H,054H	0,8,5,2	46
855	Cyrillic I	3,87	3H,057H	0,8,5,5	44
857	Turkey	3,89	3H,059H	0,8,5,7	57
860	Portugal	3,92	3H,05CH	0,8,6,0	28
861	Icelandic	3,93	3H,05DH	0,8,6,1	73
862	Hebrew NC	3,94	3H,05EH	0,8,6,2	60
863	Canada French	3,95	3H,05FH	0,8,6,3	43
865	Norway	3,97	3H,061H	0,8,6,5	27
866	Cyrillic II	3,98	3H,062H	0,8,6,6	45
869	Greek_869	3,101	3H,065H	0,8,6,9	47
874	Thailand	3,106	3H,06AH	0,8,6,4	NA
895	Kamenicky (MJK)	3,127	3H,07FH	0,8,9,5	55
1008	Greek 437	3,240	3H,0F0H	1,0,0,8	38

1009	Greek 928	3,241	3H,0F1H	1,0,0,9	39

Code Page	Country Code/ Language Set	Decimal <n_1> <n_2>	Hex <n_1> <n_2>	ASCII <n_1> <n_2><n_3>	Epson ID
1011	Greek 437 CYPRUS	3,243	3H,0F3H	1,0,1,1	41
1012	Turkey	3,244	3H,0F4H	1,0,1,2	29
1014	Polska Mazovia	3,246	3H,0F6H	1,0,1,4	22
1015	ISO Latin 2	3,247	3H,0F7H	1,0,1,5	23
1016	Serbo Croatic I	3,248	3H,0F8H	1,0,1,6	24
1017	Serbo Croatic II	3,249	3H,0F9H	1,0,1,7	25
1018	ECMA-94	3,250	3H,0FAH	1,0,1,8	42
1019	Windows East Europe	3,251	3H,0FBH	1,0,1,9	49
1020	Windows Greek	3,252	3H,0FCH	1,0,2,1	50
1021	Latin 5 Windows Turkey	3,253	3H,0FDH	1,0,2,2	51
1022	Windows Cyrillic	3,254	3H,0FEH	1,0,2,4	52
1024	Hungarian CWI	4,0	4H,000H	1,0,2,5	54
1026	ISO Latin 4	4,2	4H,002H	1,0,2,6	56
1027	Ukrainian	4,3	4H,003H	1,0,2,7	66
1028	Roman-8	4,4	4H,004H	1,0,2,8	58
1029	ISO Latin 6	4,5	4H,005H	1,0,2,9	67
1031	Hebrew OC	4,7	4H,007H	1,0,3,0	61
1032	Windows Hebrew	4,8	4H.008H	1,0,3,2	62
1033	KBL-Lithuanian	4,9	4H,009H	1,0,3,3	63
1034	Windows Baltic	4,10	4H,00AH	1,0,3,4	68
1035	Cyrillic-Latvian	4,11	4H,00BH	1,0,3,5	69
1072	Bulgarian	4,48	4H,030H	1,0,7,2	72
NA	French				1
NA	Danish I				4
NA	Italian				6
NA	Spanish I				7
NA	Japanese				8
NA	Norwegian				9
NA	Danish II				10
NA	Spanish II				11
NA	Latin American				12

Table 18 Code page definitions

Note: There is a demonstration script distributed with the CFG90 program that will print a complete character chart for IBM or EPOS modes. See the CFG90 distribution disk.

Appendix B

ASCII Code Chart

Hex	Decimal	ASCII	Hex	Decimal	ASCII	Hex	Decimal	ASCII	Hex	Decimal	ASCII
00	0	NULL	20	32	(SP)	40	64	@	60	96	`
01	1	SOH	21	33	!	41	65	A	61	97	a
02	2	STX	22	34	"	42	66	B	62	98	b
03	3	ETX	23	35	#	43	67	C	63	99	c
04	4	EOT	24	36	$	44	68	D	64	100	d
05	5	ENQ	25	37	%	45	69	E	65	101	e
06	6	ACK	26	38	&	46	70	F	66	102	f
07	7	BEL	27	39	'	47	71	G	67	103	g
08	8	BS	28	40	(	48	72	H	68	104	h
09	9	HT	29	41	)	49	73	I	69	105	i
0A	10	LF	2A	42	*	4A	74	J	6A	106	j
0B	11	VT	2B	43	+	4B	75	K	6B	107	k
0C	12	FF	2C	44	,	4C	76	L	6C	108	l
0D	13	CR	2D	45	-	4D	77	M	6D	109	m
0E	14	SO	2E	46	.	4E	78	N	6E	110	n
0F	15	SI	2F	47	/	4F	79	O	6F	111	o
10	16	DEL	30	48	0	50	80	P	70	112	p
11	17	DC1	31	49	1	51	81	Q	71	113	q
12	18	DC2	32	50	2	52	82	R	72	114	r
13	19	DC3	33	51	3	53	83	S	73	115	s
14	20	DC4	34	52	4	54	84	T	74	116	t
15	21	NAK	35	53	5	55	85	U	75	117	u
16	22	SYN	36	54	6	56	86	V	76	118	v
17	23	ETB	37	55	7	57	87	W	77	119	w
18	24	CAN	38	56	8	58	88	X	78	120	x
19	25	EM	39	57	9	59	89	Y	79	121	y
1A	26	SUB	3A	58	:	5A	90	Z	7A	122	z
1B	27	ESC	3B	59	;	5B	91	[	7B	123	{
1C	28	FS	3C	60	<	5C	92	\	7C	124	|
1D	29	GS	3D	61	=	5D	93	]	7D	125	}
1E	30	RS	3E	62	>	5E	94	^	7E	126	~
1F	31	US	3F	63	?	5F	95	_	7F	127	(sp)

Table 19 ASCII code chart

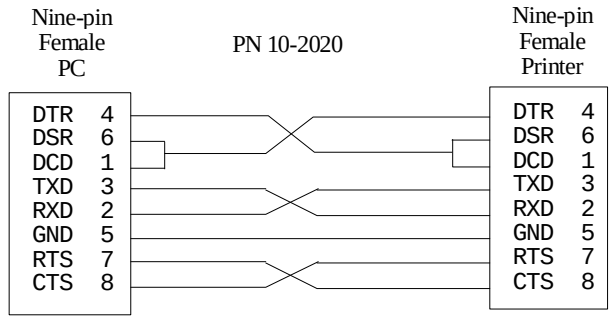
Appendix C
Ordering Cables

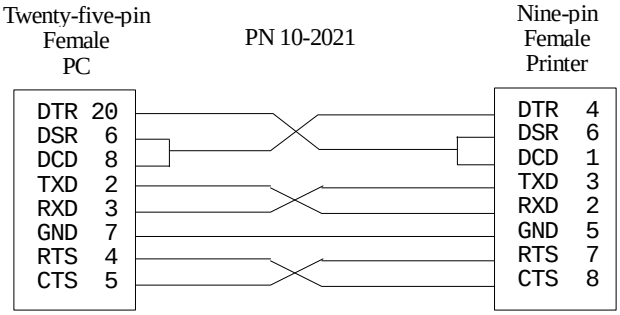
To order cables, use the following order numbers:

10-2020	9-pin female to 9-pin female serial interconnect
10-2021	9-pin female to 25-pin female serial interconnect
10-2022	9-pin female to 25-pin male serial interconnect
253-9800007	25-pin male to 25-pin male parallel interconnect

All of the above may be ordered by calling (607) 257-8901 and asking for the Sales Department. If you prefer to fax in your order, the number is (607) 257-8922. You may also order by mail. Send orders to:

Ithaca Peripherals
20 Bomax Drive
Ithaca, New York 14850





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[

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[CR] New line....18
[DC2] Set 10 cpi....33
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[ENQ] <10> Request printer reset....81
[ENQ] <11> Request printer power-cycle status....82
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[ENQ] <2> Inquire Cash Drawer 2 status....78
[ENQ] <3> Inquire receipt-paper low status....79
[ENQ] <4> Inquire receipt-paper out status....79
[ENQ] <5> Inquire slip-stop sensor status....79
[ENQ] <6> Inquire form position sensor status....79
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